MILL SECTION of Concrete

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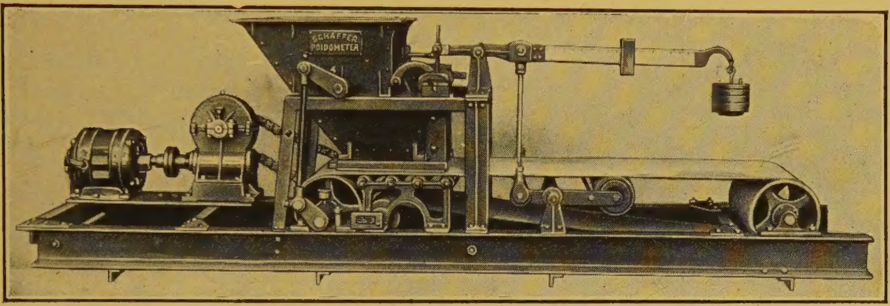

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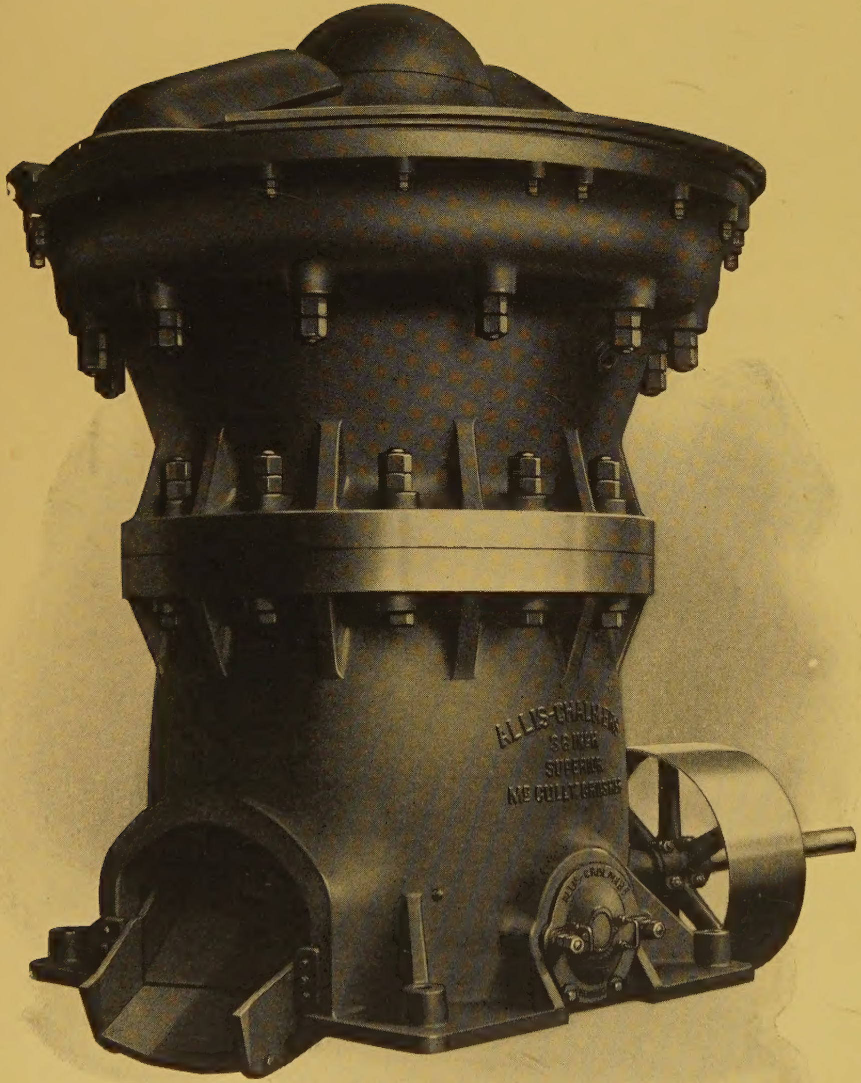

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MILL SECTION of

Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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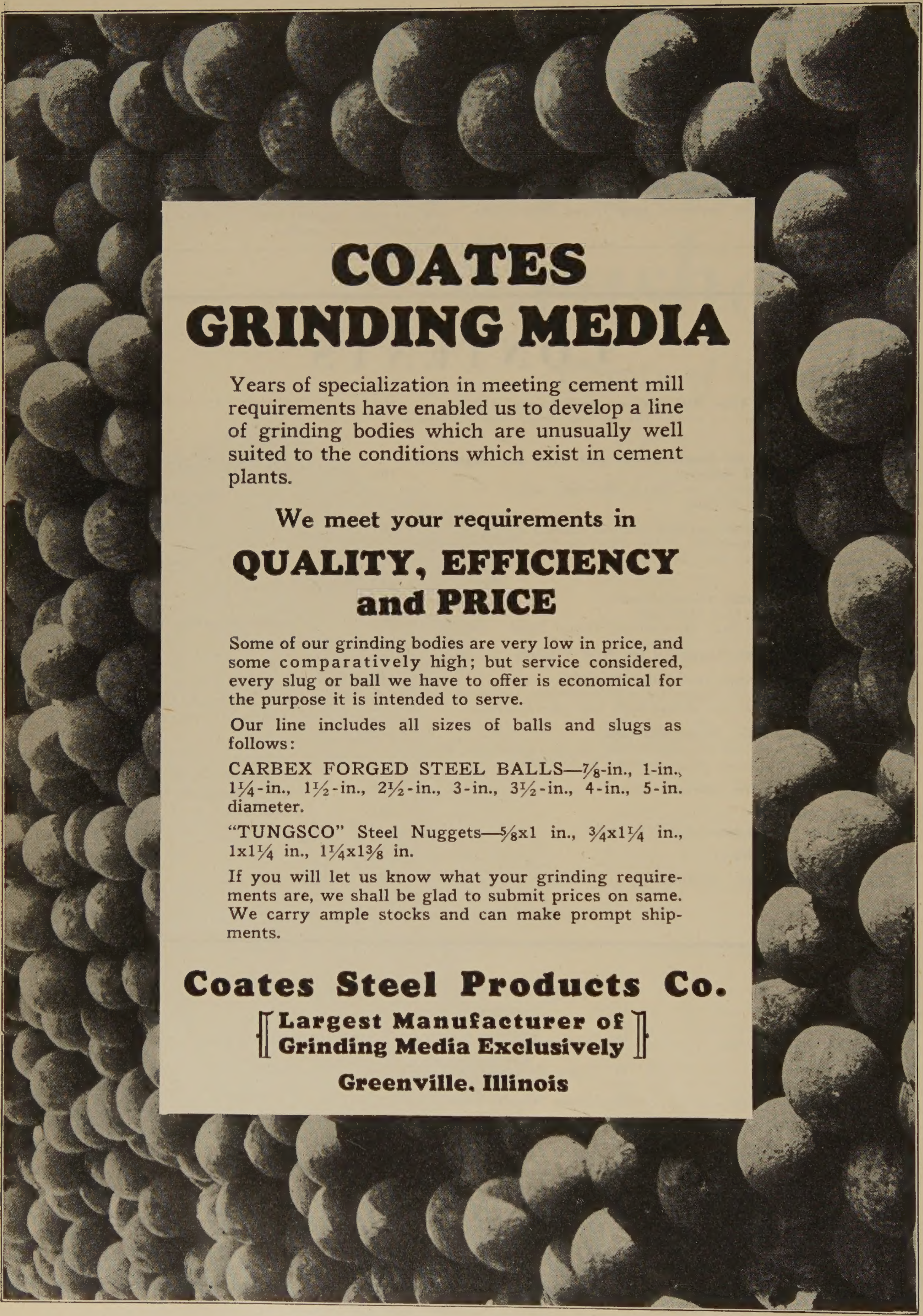

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MILL SECTION of
Concrete

Vol. 36 Chicago, April, 1930 No. 4

Fineness Tests in a Tube Mill Without Air Separator

Report of Two German Committees on Cement and on Coal—Pulverized Fuel with Admixture of Lean Fine Coal Used—Residue Found to Decrease When Input Is Reduced—Input-Fineness Curve Depends on Type of Mill and Separation

By DIPL.-ING. GROSSE, DR.-ING. FORDERREUTHER and DR.-ING. RAMMLER

IN recent years a large number of investigations on coal mills were carried out by the Committee on Pulverized Coal of the National Coal Commission, seeking to establish the laws governing the relations between the different variable quantities such as fineness, work required, input, degree of loading, moisture, etc. These tests dealt mainly with three-roll ring mills. Therefore, it appeared necessary to supplement these tests with tests of a tube mill with simple discharge. These simpler mill types, still quite prevalent in the cement industry, make the laws controlling fineness particularly apparent, for their results are not obscured by the joint action of screening or air separation. It was questioned to what extent the relations established in former tests could be applied to these simple tube mills.

Importance of Tests

These tests appeared of particular importance also because of late the tube mill with air separator has gained increasing popularity—being used with steam boilers fired with pulverized coal, its slightly higher power consumption being offset by its reliable operation and relatively low wear. Since the relations existing in a tube mill with air separator are very complex, it appeared rational to begin by making tests with a tube mill without air separator and with simple discharge, so as to determine the operation of a mill of this kind and establish the fundamental points from which further studies of the processes taking place in tube mills with air separators or screens could be developed.

The operation of a tube mill without air separator can be varied by varying the loading, the number of revolutions and the charge. The installation investigated did not permit variation of the number of revolutions without considerable remodeling, as for example, provision of high hydraulic resistance or some other alteration, since this mill was driven by a synchronous motor allowing no regulation. Neither could the charge be varied without

TABLE 1

Properties of the Coal[1]

	Per Cent
Moisture	0.92
Ash	15.21
Combustible	83.87
	100.00
Volatile constituents without water	12.23
Coke residue	86.85
Moisture	0.92
	100.00
Lowest heat value of coal	6645kcal/kg
Lowest heat value of pure coal	7930 "
Volatile constituents of pure coal	14.55%
Hygroscopic moisture	1.68%

Average grading	>7	>5	>3	>1	>0.5	>0.25mm
	8.7	14.4	32.8	59.5	78.6	89.7%

Notation:

D = the hourly input in t/h.

N_{ges} = total power required by the loaded mill, in kw.

NL = power required by mill running empty, in kw.

A_{ges} = work done, in kwh/t.

R = residues in per cent of coal dust on the standard sieves.

The following functional relations were to be recorded:

$$R = F\ (D)$$

$$N_{ges} = f\ (D)$$

$$A_{ges} = \frac{N_{ges}}{D} = \frac{f(D)}{D} = \vartheta\ (D)$$

$$A_{ges} = \Sigma(R)\ ;\ D = \varphi(R)$$

Translated from *Zement*, issue of February 27, 1930.

[1] The chemical investigations were made through the kind co-operation of Dr. Ing. Heilmann of the laboratory of the Westfalia Coal Co., Hannover.

entailing great expenditure of funds and time. Therefore, the method of loading was the only variable for which the corresponding fineness, power and work done were determined. Constant grinding resistance was assumed throughout, i. e., a variety of coal with moisture and grading as constant as possible was to be used throughout all tests. The tests were first made using an unwashed fine lean coal from the Ruhr region, whose properties are tabulated in Table 1. Tests with other varieties of coal will follow.

Description of the Mill

The mill will be described here only to the extent warranted by the purpose of the present report. It serves to feed pulverized coal to the kiln bunker and two reserve bunkers of a rotary cement kiln. Pulverized coal with a high content of volatile constituents is used with an admixture of a fine lean coal or of an unwashed fine anthracite coal. According to the moisture content, the coal is either pulverized directly or is previously dried in a gas-fired drum dryer. As a rule the coal dust is led through an air separator before being pulverized. The combination of different varieties of coal with different moisture content and grading requires the provision of numerous devices for regulation. Accordingly the installation is provided with an extensive conveying system (screw conveyors and elevators).

The mill itself is a three compartment mill (Solo mill) furnished by the firm of Polysius, Dessau, 9m. in length and 1.5m. in diameter. Compartments I and II (preliminary and coarse grinding) have a cast steel lining and are filled with steel balls. Compartment III (fine grinding) has a silex lining and a flint charge. The charge has a total weight of 5.1 tons and is made up as follows:

Compartment I	500 kg. steel balls	50mm.	diam.
	800 “ “ “	40 “	“
	700 “ “ “	30 “	“
Compartment II	2400 “ “ “	20-30 “	“
Compartment III	700 flint stones		

The mill is driven by a synchronous motor of 110 kw. The coal to be ground is brought by means of screw conveyors and elevators and discharged into a bunker above the mill of 5 tons capacity. A throwing plate provided under the discharge end of the bunker feeds the mill uniformly. The pulverized coal leaving the mill is conveyed by a screw conveyor. The mill installation is kept dust free by a suction filter, to which, among the rest, are connected the feed and discharge ends of the mill. The coal dust thus recovered is returned to the pulverized coal conveyor by gravity.

Testing Procedure

The six different test conditions were produced by varying the position of the adjustable brush on the feeding disc or throwing plate—the device regulating the feeding of the mill. In each test the duration of test, the total input and the work required were recorded. As the coal used in the test had absorbed up to 11 per cent moisture during storage, it had to be dried before pulverizing was possible. The input was measured by weighing the coal before feeding it to the mill (upon drying). With this in view the trough of the screw conveyor feeding the mill (between discharge of dryer and mill) was cut open over a corresponding width and length. The coal which fell through was caught in barrels, weighed on a calibrated decimal scale and returned to the conveyor. Weighing the coal before drying and computing the weight of dried coal from the moisture content of coal before and after drying was considered too inexact and was to be used only in an emergency. Aside from the dried coal, the weight of escaped dust was also recorded after it was caught into bags from the gravity chutes mentioned above.

The work required was recorded in kwh. by the mill motor. The only accessory driven by the mill motor is the throwing disc; all dust collecting and conveying devices for the coal before and after pulverizing have independent driving motors, so that the power consumed by the mill and the feeding device could be measured directly. The power furnished by the individual motors for dust collecting and conveying of the pulverized coal from mill to bunker and of coal from dryer to mill was read off the commercial ammeters and voltmeters. Since the latter were not calibrated, these measurements have value only as information.

In preliminary tests the power consumed by the mill, when running empty, was found on the average to be $N_L = 102$kw., reduced by the power factor to $0.9 \times 102 = 91.8$kw. The number of revolutions was determined as $n = 27$ r.p.m.

Constant moisture and grading were requisites for obtaining useful and comparable data, since otherwise no consistent relations could have been observed between fineness on the one hand and input and work required on the other hand. For with equal values of input the tube mill reacted to variations of resistance to grinding not by variations in work required, but by variations in fineness, as will be pointed out later. It was found that the dryer could be better controlled for more intensive drying. As the initial moisture content of the coal was not uniform, and, furthermore, as the dryer was fired by hand and considerable variations in the temperature of the heating gases were unavoidable, differences in final moisture content could not be prevented. The amplitude of these variations, however, became reduced with more intensive drying. Moisture was, therefore, kept as close to 0.5 per cent as possible. A check on moisture was obtained on samples by quick tests at intervals of half an hour, namely, by heating the coal for 20 minutes at a temperature of 130 deg. C. The values thus obtained were relative only, yet were sufficient for judging whether the moisture content was kept constant.

Strictly constant grading could not be maintained, since even the initial coal showed some segregation due to repeated handling. Some segregation also took place in the feeding bunker and particularly in the bunker directly before the mill, so that toward the end of the test the coal fed to the mill was almost entirely coarse. However, variations in size are not of as great influence on grinding as are variations in moisture.[2]

According to the input and the duration of test, samples of mill dust and collected dust were examined every 15 to 30 minutes. To obtain indications of the fineness, samples of mill dust were made to pass the No. 70 and No. 30 sieves, in accordance with the usual industrial procedure. The total samples as well as some of the individual samples were then separated once more with laboratory accuracy on the sieves designed by Förderreuther-Chemical Laboratory for the Clay Industry[3], this procedure being repeated. The sieves included the standard Nos. 100, 80, 70, 50, 40 and 30. Samples were also taken from time to time from the dried coal and incorporated in one general sample, which was tested for size and moisture content.

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[2] When coal still uniformly mixed is fed into an originally empty bunker, it first fills the lower section of the hopper and then gradually forms a cone, as the diameter increases; further drop of the coal on this cone, whose apex lies somewhere near the axis of the bunker, causes the fines to settle at the top around the apex, while the coarse sizes slide off and settle around the edge of the bunker. When coal is drawn from a bunker filled in this manner, the first layer to descend is that directly above the feeding disc, i. e., in the center of the bunker, whereupon a steeply tapering funnel is produced after the manner of a whirlpool, through which the coal fed into the bunker descends directly in a uniformly mixed condition. If the supply is interrupted and no more coal is discharged into the bunker, the masses accumulated around the edges finally become detached, so that towards the end of the test only coarse particles of coal enter the mill.

[3] See *Zement*, Nov. 11, 1928.

Table 2 gives the sieve analyses of the samples; Fig. 1 represents graphically the average grading obtained in all tests.

TABLE 2

Grading of Coal

Test No.	Size (mm.) Per Cent >7	>5	>3	>1	>0.5	>0.25
II	6.2	10.5	20.85	43.9	66.0	82.8
III	5.5	11.6	25.8	52.4	73.45	86.6
V	6.0	13.0	31.2	60.3	79.8	90.1
IV	6.3	12.7	28.9	57.6	79.8	92.1
I	18.9	32.9	54.8	77.1	87.6	92.8
VI	9.3	17.6	35.1	65.6	84.9	94.0
Average	8.7	16.4	32.8	59.5	78.6	89.7

Test Procedure

To take into account the requirement, that grinding tests should refer to continuous operation and that conditions at the beginning and end of test should be exactly the same, the following procedure was employed: Before starting the test proper the feeding disc was set on the desired value, the previously emptied mill bunker was sufficiently filled and the mill allowed to run under test conditions until this supply was pulverized. At the moment when the last coal was leaving the bunker feeding the mill, the latter was stopped. The duration of this preliminary test was established with sufficient accuracy to leave in the mill at the end of this test the quantity of coal corresponding to the regular test conditions. The time required to reach this point was specially determined. It is to be noted in this connection that apparently in a tube mill this state is reached sooner with respect to the charge than with respect to fineness, which is achieved considerably later. Upon completion of this preliminary test, the mill bunker was again filled and the mill set in operation for the main test. The end of test was reckoned as the moment when the last of the coal was entering the mill. The test, therefore, began and ended with the mill loaded as specified.

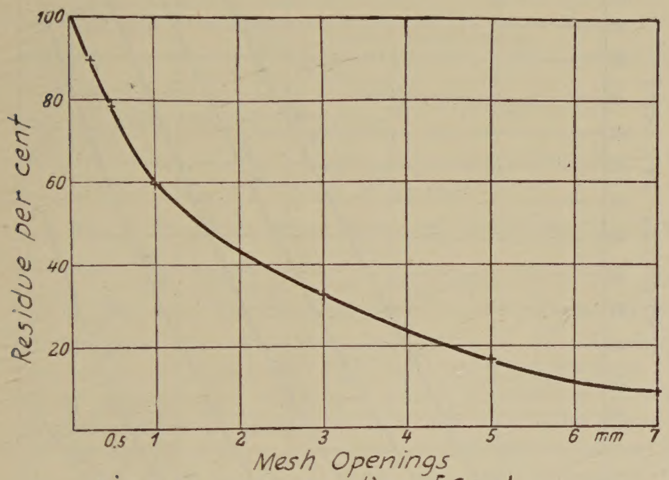

Fig.1 Average Grading of Coal

As the tests had to comply to the requirements of operation, the duration of test could not be extended to 6 and 8 hours, as was desired and formerly expected; 2 to 4 hours' duration had to suffice. However, including the preliminary test, the time required by each test seldom fell below 8 hours.

The test results are tabulated in Tables 3 to 5, which also show their evaluation. The observed values of power consumed and work done were corrected by means of the power factor of the driving motor.

TABLE 3

Mill Dust

Test No.	Input	Residue on Sieve No.* 100	80	70	50	40	30
II	0.87	9.6	5.6	3.3	1.3	0.6	0.2
III	1.39	14.5	8.2	4.4	1.5	0.3	0.2
V	1.79	19.7	12.4	7.1	2.5	0.8	0.5
IV	2.39	26.2	18.1	11.5	4.9	1.2	0.5
I	3.02	34.3	25.1	18.5	9.6	3.2	1.1
VI†	5.27	60.7	54.0	48.6	38.0	27.2	16.2

*The sieve numbers refer to the German standard sieves in accordance with DIN 1171:

No. 100	10000 mesh per sq. cm.	60	mesh opening
No. 80	6400 "	75	"
No. 70	4900 "	88	"
No. 50	2500 "	120	"
No. 40	1600 "	150	"
No. 30	900 "	200	"

†In test VI the input corresponded to the capacity of the mill; during this attempt to load the mill to the limit the coal was crowded back into the feeding device from the mill compartment.

TABLE 4

Test No.	Average moisture Per Cent	Fineness Per Cent (No. 70)	Input t/h	Power consumed not reduced kw	reduced kw	Work done not reduced kwh/t	reduced kwh/t
II	0.37	3.3	0.87	101.8	91.6	116.7	105.2
III	0.47	4.4	1.39	101.9	91.7	73.3	65.9
V	1.04	7.1	1.79	100.5	90.5	56.3	50.6
IV	0.16	11.5	2.39	102.1	91.9	42.7	38.4
I	1.04	18.5	3.02	102.0	91.8	33.7	30.4
VI	1.11	48.6	5.27	101.7	91.65	19.4	17.5

TABLE 5

Dust From Dust Collector

Test No.	Input	Dust from collector kg/h	Per Cent of input	Fineness Per cent retained on sieve No. 100	80	70	50	40	30
II	0.87	72.3	8.3	4.72	2.12	0.84	0.40	0.24	0.16
III	1.39	54.3	3.9	6.28	2.04	1.08	0.44	0.24	0.08
V	1.79	51.4	2.9	8.52	3.56	2.34	0.64	0.44	0.36
IV	2.39	......	....	7.76	3.70	1.68	0.34	0.22	0.15
I	3.02	85.8	2.8	8.32	5.06	2.60	1.10	0.26	0.09
VI	5.27	68.5	1.3	8.80	4.76	2.20	0.76	0.48	0.32

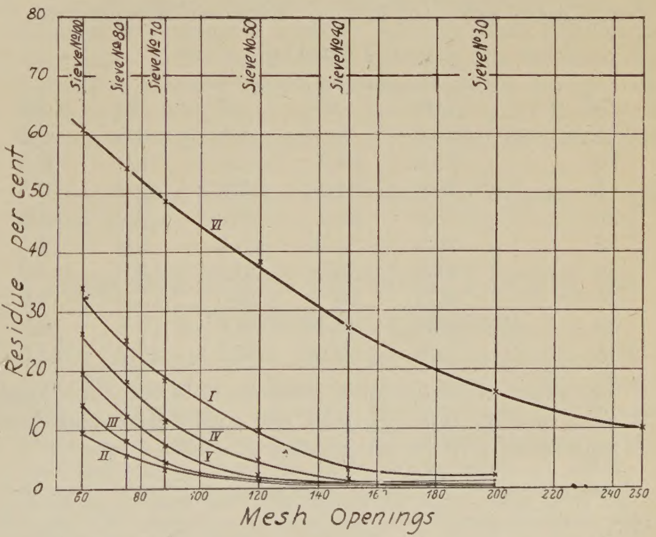

Fig. 2 Fineness Characteristics

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[4] Compare Rosin-Rammler, "Evaluation of Sieve Analyses and Characteristic Curves of Coal Dust," *Archive of Heat Economy*, 1926, No. 2: 3rd report of the Pulverized Coal Committee of the National Coal Commission.

Fig. 2 shows the characteristic curves[4] of the coal dusts obtained. The fineness range covered by the tests extends from 3.3 to 48.5 per cent residue on sieve No. 70 and from 0 to 16 per cent residue on sieve No. 30. The dusts were to be classified further by air separation in accordance with Gonell's process throughout the range of sizes 0 to 60 μ, which include the predominant dust sizes and which cannot be separated by means of sieves. The results of air separation will be described at a later date.

Relation Between the Residues

Fig. 3 shows the residues on sieve No. 70 platted as abscissae and those on sieves No. 100, 80, 70, 50, 40 and 30 as ordinates. This graph illustrates the relations between the residues and may serve to read off the entire gradation of sizes within the range of sieve analysis, when given but one flawlessly accurate analysis of a coal dust on a flawlessly correct sieve No. 70. In Table 6 this relation is given again for fineness variations of 5 per cent.

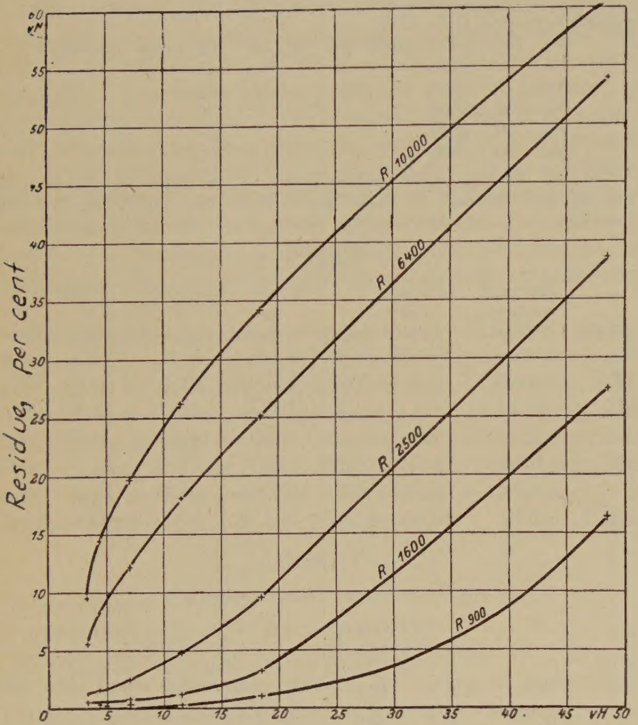

Fig. 3 Relation between the Sieve Residues

TABLE 6

Residue on Sieve No.

70	100	80	50	40	30
5	15.2	9.5	1.8	0.5	0.2
10	24.5	16.5	4.0	1.0	0.3
15	30.0	21.5	7.0	2.0	0.5
20	35.0	26.5	11.0	4.2	1.3
25	40.5	31.0	15.5	8.0	2.4
30	44.5	36.0	20.5	12.0	3.9
35	48.5	40.5	25.0	15.8	5.9
40	53.0	45.2	29.8	19.5	8.8
45	57.0	50.0	34.5	23.2	12.8

The extent to which these relations hold for other kinds of coal in other types of mills and with different methods of separation will be investigated at another time.[5]

From the trend of the curves and the position of the bend one can conclude that pulverizing the coal in question in this particular mill to a fineness greater than 15 per cent retained on the No. 70 sieve results in only slight further decrease of the amounts retained on sieves Nos. 50, 40 and 30, which means that no further improvement can be sought. On the other hand, the percentage of the fines (passing the sieves No. 80 and No. 100) increases considerably for residue on the No. 70 sieve lower than 10 per cent, so that the work required for additional grinding must increase tremendously. Relations developed further confirm these deductions.

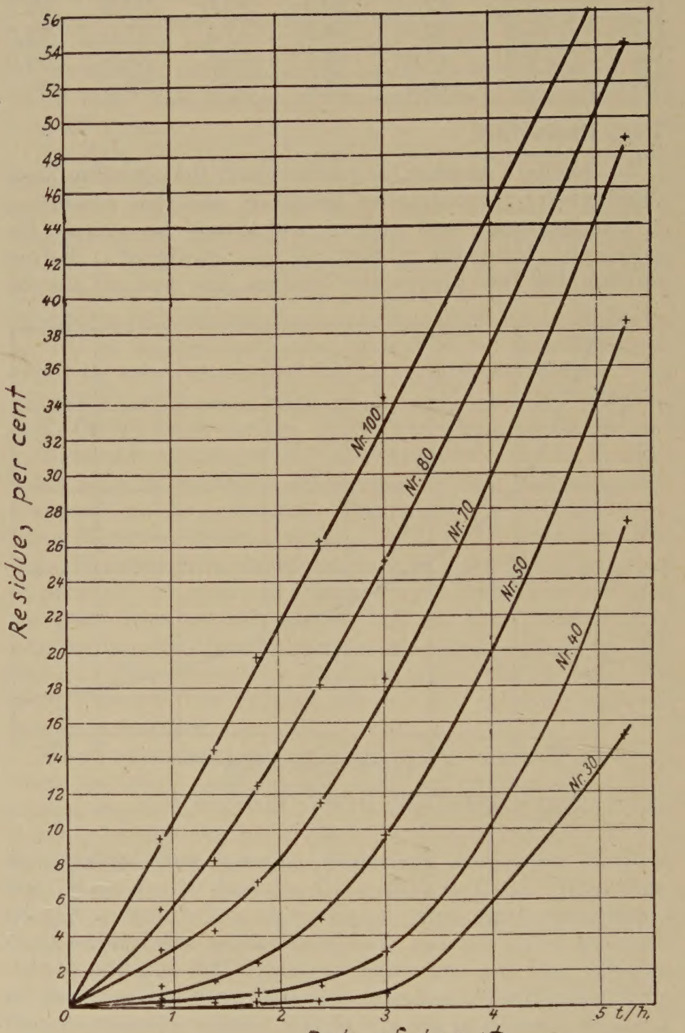

Fig. 4 Fineness - Input Relation.

Fineness and Input

Fig. 4 shows the residues on sieves Nos. 100 to 30 platted as a function of the rate of input, the curve of the basic sieve No. 70 being particularly emphasized. The residues decrease, i. e., the fineness increases, when the input is reduced. With an input of 1 t/h the fineness is 3.5 per cent on the No. 70 sieve, while with an input of 5 t/h this residue becomes 45 per cent. The variation in fineness is not proportional to the input. For equal reductions of the input the increase in fineness (decrease in residues) is the smaller, the higher the fineness range.

The tube mill provided with no screens or air separator reacts to a reduction of input in a manner similar to that of the previously investigated Fuller mill with screens,[6] and, speaking generally, in a manner probably common to all mills with screen separation, while, on the other hand, the three-roll ring mills with elevator and mechanical air separator always show decrease in fineness with decreased input.[7] However, the trend of the input-fineness curve depends entirely on the type of mill and separation and especially on the combined effect of the two.[8]

---

[5] Compare Rosin-Rammler, "Fineness and Structure of Pulverized Coal as Influenced by the Kind of Coal and Type of Mill." 5th Report of the Pulverized Coal Committee of the National Coal Commission. *Zement,* 1927, No. 35-38. *Zeitschr. d. Ver. Deutsch, Ing.* 1927, No. 1. Rammler, "Investigat. of Measurements and Eval. of Fineness of Pulv. Coal." 7th Rep. Pulv. Coal Com. of Nat. Coal Com.

[6] See Rosin-Rammler, "Power Consumption in Coal Pulverizers, Part III, Investigations of a Fuller Mill with Screens." 12th Report of the Pulverized Coal Committee of the National Coal Commission, *Archive of Heat Economy,* 1927, No. 8.

Power Consumed and Input

The power consumed, N_{ges}, is practically constant in its relation to input (Fig. 5). It is equal to the power consumed by the empty run of the mill N_L, i. e.:

$$N_{ges} = f\,(D) = N_L = \text{const.} = 91.8 \text{ kw.}$$

The variations from the empty run value amount to 1.4 per cent as a maximum, i. e., they lie within the possible error.[9] An additional power expenditure $N_N = N_{ges} = N_L$ is, therefore, not encountered in a mill without screens or air separator. This is probably true of all such mills as well as all high power mills with screen separation. If at all present, this additional power expenditure is very slight. Earlier grinding tests in a tube mill without screen or air separator have shown that such slight variations of the total power consumed from the power consumed by the empty run of the mill may occur, this slight variation in power demand being either positive or negative according to the nature of the coal used, i. e., it may happen that the mill, when loaded, requires less power than it does when operated empty. Yet a mill, when loaded, in contrast to the empty run, does useful work in producing coal dust, i. e., in overcoming the cohesion of the coal particles to a large extent. Further, a live load of coal dust is added to the dead load constituted by the weight of the mill itself plus the mill charge. Finally, the mill has the additional work of transportation in lifting the coal at every revolution. The reason for this behavior of the tube mill was discussed at an earlier date.[10]

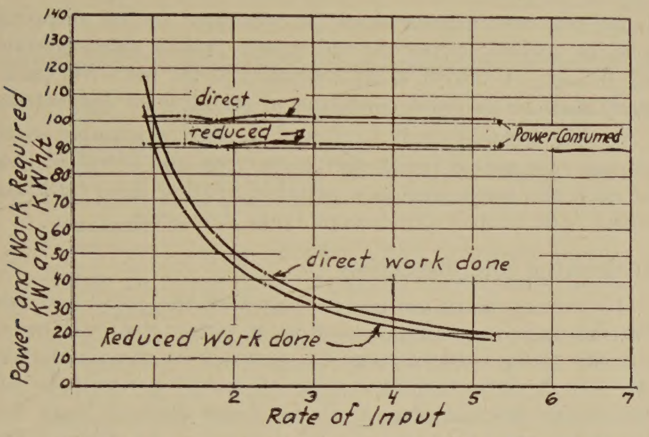

Fig. 5 Power and Work Required in Relation to Input.

(To be continued.)

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[7] See Rosin-Rammler, "Power Consumption of Coal Pulverizers, Part I," 3rd Report of Pulverized Coal Comm. of the National Coal Commission, *Arch. of Heat Economy*, 1926, No. 2. Rosin-Schulz, "Power Cons. of Coal Pulv. Part II, and III," 9th report as above, *Arch. of Heat Econ.*, 1927, No. 3 and 4.

[8] *See also Zeitschr. d. Ver. Deutsch.* Ing., 1928, p. 1389.

[9] A discrepancy of 1.4 per cent was found in test V (see Table 3); in all other tests this discrepancy is less than 0.25 per cent. The average power consumed in the 6 tests is 91.5 kw as against 91.8 kw of the empty run.

[10] See Rosin, "Characteristics of Coal Pulverizers," *Archive of Heat Economy*, 1926, No. 10. 2nd report of the Pulverized Coal Committee of the National Coal Commission.

Effect of 1929 Construction Decrease Shown in Penn-Dixie Report

Report of the Pennsylvania-Dixie Cement Corporation and subsidiaries for year ended December 31, 1929, shows net profit of $332,268 after depreciation, depletion, interest, federal taxes, etc., equivalent to $2.44 a share on $13,588,800 preferred 7 per cent stock. This compares with net profit of $1,283,851 equal after preferred dividend requirements to 90 cents a share on 400,000 no-par shares of common stock in 1928.

Senate Votes Eight-Cent Tariff on Cement

The United States Senate on March 7th reversed its prior action of January 31st by voting a tariff of six cents a hundred pounds on portland cement, this rate having stood at the time of passage of the Senate bill on March 24th.

Eight cents per bag is called for by the bill as passed by the House of Representatives and the joint committee will now attempt to effect an agreement.

Mississippi State Body Proposes Cement Plant; Arizona Follows Suit

The joint legislative committee of Mississippi has recommended that the state build its own cement plant for manufacturing highway cement.

The bill concerning the project proposes a $2,000,000 bond issue to be paid at the rate of one-tenth each year out of gasoline tax fund, all profits to go into the highway fund. The plant, to be located in a location deemed best, would employ convicts.

The establishment of a cement plant and launching of a road-building and improvement program with prisoners furnishing the labor, was urged by Superior Judge Marlin T. Phelps of Arizona, as a solution to the problem of idleness in the state penitentiary.

"I have heretofore suggested that the legislature provide funds for the construction of a cement plant for the manufacture of cement, operated with prison labor and under the management of a competent person removed from political influence, and that such cement to be used in construction of highways throughout the state, by prison labor.

"Our transcontinental highways, as well as necessary roads north and south, to connect them, could thus be built."

Keystone Contracts to Double Shipping Facilities

The Keystone Portland Cement Company, Bath, Pa., has recently closed a contract with the Rust Engineering Company at Pittsburgh, Pa., covering the erection of a battery of nineteen concrete silos for cement storage. Two additional packhouses, having two three-spout Bates packing machines in each packhouse have also been contracted for.

These added facilities will double the shipping capacity of the plant.

Medusa Stock Receives Listing on Cleveland Exchange

The Cleveland, Ohio, stock exchange on March 1st listed 177,615 shares of no-par common stock of the Medusa Portland Cement Company. The firm was incorporated under West Virginia laws in 1892 as the Sandusky Cement Co. and changed to an Ohio corporation in 1900. In March, 1916, the name was changed to the Sandusky Cement Co. and the present name became effective April, 1929.

The New A. S. T. M.

Specifications and Tests for High Early Strength Portland Cement

American Society for Testing Materials Submits New High Early Strength Cement Specifications—Properties, Packing—Inspection—Methods of Testing

THE new "Tentative Specifications and Tests for High Early Strength Portland Cement" have been issued in printed form by the American Society for Testing Materials under the serial designation of C 74-30 T.

Criticisms of this tentative standard should be addressed to F. H. Jackson, Chairman of Committee C-1 on Cement, U. S. Bureau of Public Roads, Washington, D. C. The specifications follow:

1. High-early-strength portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

Chemical Properties

2. The following limits shall not be exceeded:

Loss on ignition, per cent	4.00
Insoluble residue, per cent	0.85
Sulfuric anhydrite (SO_3), per cent	2.50
Magnesia (MgO), per cent	5.00

Physical Properties

3. The residue on a standard No. 200 sieve shall not exceed 22 per cent by weight.

4. A pat of neat cement shall remain firm and hard, and show no signs of distortion, cracking, checking, or disintegration in the steam test for soundness.

5. The cement shall not develop initial set in less than 45 minutes when the Vicat needle is used or 60 minutes when the Gillmore needle is used. Final set shall be attained within 10 hours.

6. The average tensile strength in pounds per square inch of not less than three standard mortar briquets (see Section 47) composed of one part of cement and three parts of standard sand, by weight, shall be equal to or higher than the following:

Age at Test, Days	Storage of Briquets	Tensile Strength, lb. per sq. in.
1	1 day in moist air	275
3	1 day in moist air, 2 days in water	375

7. If, at the option of the purchaser, a 28-day test (with storage of 1 day in moist air and 27 days in water) is required, the average tensile strength obtained at 28 days shall be higher than the strength obtained at 3 days.

Packing, Marking and Storage

8. The cement shall be delivered in packages as specified with the brand and name of the manufacturer plainly marked thereon, unless shipped in bulk. When shipped in bulk, this information shall be contained in the shipping advices accompanying the shipment. A bag shall contain 94 lb. net. A barrel shall contain 376 lb. net. All packages shall be in good condition at the time of inspection.

9. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight building which will protect the cement from dampness.

Inspection and Rejection

10. Every facility shall be provided the purchaser for careful sampling and inspection at either the mill or at the site of the work, as may be specified by the purchaser. At least 6 days from the time of sampling shall be allowed for the completion of the 1-day tests, 8 days for the 3-day tests, and at least 33 days shall be allowed for the completion of the 28-day tests. The cement shall be tested in accordance with the methods hereinafter prescribed.

11. The cement may be rejected if it fails to meet any of the requirements of these specifications.

12. Cement remaining in storage prior to shipment for a period greater than 6 months after test shall be retested and shall be rejected if it fails to meet any of the requirements of these specifications.

13. Cement shall not be rejected on account of failure to meet the fineness requirement if upon retest after drying at 100 deg. C. for one hour it meets this requirement.

14. Cement failing to meet the test for soundness in steam may be accepted if it passes a retest using a new sample at any time within 28 days thereafter. The provisional acceptance of the cement at the mill shall not deprive the purchaser of the right of rejection on a retest of soundness and time of setting at the time of delivery of cement to the purchaser.

15. Packages varying more than 5 per cent from the specified weight may be rejected; and if the average weight of packages in any shipment, as shown by weighing 50 packages taken at random, is less than that specified, the entire shipment may be rejected.

Methods of Testing

16. The cement shall be sampled and tested in accordance with Sections 16 to 57 of the Standard Specifications and Tests for Portland Cement (A. S. T. M. Designation: C 9) of the American Society for Testing Materials* except that in Section 26 the sulphuric anhydride content shall be reported as 2.50 per cent when all results are in excess of the specified limit but within the permissible variation of 0.10 per cent.

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*1927 Book of A. S. T. M. Standards, Part II, p. 23.

Variations in Standard Portland Cements

Report of Committee 202 of A. C. I. Finds Too Much Attention Centered on Strength—Investigation of Other Properties Neglected—Much Data Still Lacking

By P. H. BATES
U. S. Bureau of Standards, Washington, D. C.

> "In investigative work in which cement might properly have been considered a variable," says Mr. Bates in his concluding remarks in this report, "it was assumed to be a constant.
>
> "In this paper an effort has therefore been made to show that it would have been just as logical to assume that various cements might at any time have different physical properties. The urgency of studying all the properties of concrete, as resulting in a major degree from the quality of cement, is stressed.
>
> "There can be no constituent of concrete more worthy of study than the cement, yet as an essential constituent of concrete it has been studied less than any of the other components."

THE sub-topics under discussion cover questions of much interest to all studying and intelligently trying to use cement and concrete, and many data should be available. But a search of the literature reveals that in general the data are extremely meager. In fact it would seem that in most studies of concrete cement was not considered to be one of the variables and seldom are any of the characteristics of the cement presented, other than it was a standard portland cement and met the requirements of the standard of the American Society for Testing Materials or other similar organizations. Indeed, even when strength is under investigation there has been a steady effort in many outstanding researches to obliterate any apparent effect of the use of different standard cements by using a mixture of a number of them. Under such conditions one is confronted with paucity of data, notwithstanding the need of many. It is believed that this report will have more value in emphasizing this lack and, to a considerable degree, the need of data, than in citing what is actually available under the several designated headings.

It is felt also that the discussion will dispel the erroneous idea that there is such a thing as a standard portland cement. It is true that all manufacturers of the commodity make an especial effort to have it pass a certain set of standard requirements, but in so doing it has resulted that not only does the product of the majority of mills meet these at all times but the product may exceed these requirements to various degrees at any time. It is further believed that this discussion may serve to indicate that portland cement does develop other properties than those of hardening and acquiring strength. It is hoped that it will be made clear that some properties, as volume changes and heat developed during the reaction with water, may be so paramount in special cases as practically to force the ignoring of strength.

Variations in Early Strengths

Three years ago few were making any tests of other than neat tensile briquettes at ages earlier than 7 days. Then

TABLE I

Tensile Strength of Standard Sand Briquettes

Average in lbs. per sq. in. obtained by 46 laboratories using 32 brands

Cement No.	3-Day Tests	7-Day Tests	28-Day Tests
1	275	350	445
2	240	330	440
3	210	260	375
4	190	260	370
5	250	315	395
6	230	310	400
7	230	310	405
8	205	285	405
9	195	290	380
10	195	255	375
11	210	295	390
12	235	305	390
13	255	330	430
14	205	285	400
15	215	290	385
16	205	270	375
17	220	290	385
18	185	260	375
19	185	260	375
20	160	235	360
21	255	325	405
22	255	325	410
23	220	285	390
24	260	335	405
25	205	270	390
26	180	265	375
27	230	290	380
28	170	230	345
29	245	325	420
30	195	265	365
31	210	275	380
32	200	265	375
Average value	215	290	390
High value	275	350	445
Low value	160	230	345

Abstract of report of A. C. I. Committee 202, of which P. H. Bates is author-chairman.

the efforts of some portland cement manufacturers to manipulate the making of their product so that it might come into the class of the high alumina cements, so far as high early strength was concerned, led to the breaking of test specimens after aging two or three days. But in the great majority of cases such testing has been confined to the making and breaking of tensile briquettes so that essentially there are few data available.

Committee C-1 of the American Society for Testing Materials, however, at the 1928 meeting of the society presented a report of work wherein a group of laboratories had carried out certain strength tests of 32 brands of cement obtained from warehouses scattered throughout the United States.[2] Forty-six laboratories reported the strengths at 3, 7 and 28 days, of standard sand briquettes made from these cements. The average of the strengths so reported is given in Table I. Two laboratories reported the strengths of 6 by 12-inch cylinders, made of a 1:2.4:3.6 concrete, at 3 days, and four other laboratories in addition to these two obtained the strengths of the same concrete at 7 and 28 days. The averages of these values, as well as the strength at one year, obtained by one of the laboratories, are given in Table II.

TABLE II

Compressive Strength of 32 *Brands of Portland Cement*

Average compressive strengths, lbs. per sq. in.

Compression tests of 6 by 12-in. concrete cylinders.

Mix 1:2.4:3.6 by weight (5 lb. cement, 3 lb. water, 12 lb. sand, 18 lb. coarse aggregate per batch).

Three-day results are averages from two laboratories.

Seven- and 28-day results are averages from six laboratories.

One-year results are averages from one laboratory.

Cement No.	3-Day Tests	7-Day Tests	28-Day Tests	1-Year Tests
1	1610	2840	4000	5140
2	1270	2200	3500	6190
3	1150	1940	3200	5680
4	880	1490	2610	4540
5	1370	2360	3550	5220
6	1300	2200	3430	4810
7	1080	1900	3220	4910
8	1010	1690	3200	5240
9	880	1870	3090	4620
10	880	1570	2820	4290
11	1070	2000	3240	4960
12	1160	1960	2960	5060
13	1340	2140	3700	5470
14	1060	1880	3270	5610
15	1170	1820	3290	4860
16	1090	1850	3140	4840
17	1270	2160	3660	5230
18	880	1490	2940	4640
19	1020	1670	2880	4950
20	820	1230	2360	4550
21	1460	2220	3400	4800
22	1470	2430	3880	4980
23	1180	1750	3040	5200
24	1240	2190	3390	4980
25	1040	1540	2850	5070
26	710	1220	2140	4070
27	1160	1740	2750	4360
28	680	1190	2370	5350
29	1180	1960	3260	4940
30	940	1610	2840	4830
31	1040	1530	2950	5230
32	920	1530	2870	5250
Average	1100	1850	3120	5000
High	1620	2780	4030	6190
Low	600	1070	2090	4070

These tables require but little comment. They serve to show quite strikingly that the cements of the type now on the market do vary considerably in strength, whether tested at early or later ages, either as mortar briquettes or as concrete cylinders. They further show that these deviations in concrete strength are still very marked at periods as late as a year. Strengths even at one year are in reality only a matter of some special interest and of no particular value. All structures must be in use in whole or in part so long before one year that the strength upon which they are built must have been developed long before that age. Further one year is too short a period to furnish any indication of permanency in the great majority of cases. Hence the one-year strengths can be of little practical value.

In the majority of cases there is a definite relation between early briquette strength and early concrete strength, as indicated by Fig. 3 of the Committee C-1 report. But this same figure shows the large number of exceptions. Further, one is not interested so much in the average strength of a group of cements as he is in those that deviate markedly from the average. To one contemplating the use of a cement the fact that 32 brands, in a certain kind of concrete, gave an average strength at 3 and 7 days of 1100 and 1850 pounds per square inch, respectively, has not nearly so much value as the fact that at 3 days one cement showed an average strength of 710 pounds per square inch and another 1610 pounds per square inch, while at 7 days one gave an average strength of 1190 pounds per square inch and another 2840 pounds per square inch.

Other interesting facts than the early strengths can be noted in these tables. Thus it can be seen that the cements testing lower at early ages show a greater gain in strength with age than do the higher testing ones. Cements 1 and 2 are of special interest in this respect. The latter gave a concrete strength at 3 days 25 per cent lower than the former, but at 1 year No. 2 has a greater strength than No. 1.

The interest in high early strength concrete is resulting in the rapid accumulation of data. However, the work of Committee C-1 which has been cited is so representative of commercial practice that it is hardly necessary to cite other data.

Workability

At the present time the term "workability" is very much to the fore in discussions of cements and concretes. Since this term is used to describe that condition of mortars or concretes under which they can be readily worked into forms or around reinforcing without segregation, it can be appreciated that it is a matter of much concern. This is particularly true since it is now so thoroughly realized that attempts to secure this property through the agency of increased amounts of water result only in lower strengths and increased likelihood of segregation. Furthermore, the increased demand for high testing, so-called "plastic" mortars and the increased use of concrete prepared at central mixing plants and hauled considerable distances before placing, has still further emphasized the workable properties of such materials. Finally the matter is brought to a climax by the sales of certain agents reputed to develop workability when added to mortars or concretes.

The investigations dealing with the relative workability of different cements have been confined to a study of this quality as developed by neat cement pastes. The earliest efforts were directed more towards measuring what is referred to as "consistency," and as a result the well-known Vicat needle was developed. The use of this indicated differences between portland cements and this is recognized in specifications for portland cements. But what it measures is essentially not "workability." The device needed must be such that there will be measured the ratio between flow and the pressure causing the flow, especially at different rates of flow. Three such devices have been tried and the results presented before this Institute in 1928.[3] That paper is so recent that it need only be said that each of the methods showed that there was a difference in the workability of the twelve cements used.

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[2] *Proc.* Amer. Soc. for Testing Materials, Report of Committee C-1, Vol: 28, Part 1, pp. 232-306. (1928.)

Shrinkage

It is believed that the information desired under this heading would more likely be referred to as phenomena noted through the volume changes in concrete during the setting and hardening, without regard to any superimposed load. There has been a considerable amount of work devoted to noting the changes in volume (more properly, changes in one dimension only) of various kinds of concrete during the setting and early hardening, as brought about by the chemical reaction of the cement and water incident to the development of strength. One always associates Bauschinger with volume changes as a result of his pioneer studies in this field in 1879. He was apparently interested in the deportment of different cements in this respect, for he used eight different ones in his studies. The other early investigators also used different cements, but confined their studies to neat specimens or mortars. But in more recent years the variables studied have been types of aggregate, proportioning of the mix, amount of water used, temperatures and humidities during storage, etc. It has been assumed either that the cement was of little influence in affecting any volume change or that the amount of cement used in a concrete was, relative to the aggregates, so small that it could have but little effect.

White, one of the earlier and most prolific investigators in this country of the subject of volume changes, in his second paper[4] makes the statement, after mentioning the use of four different portland cements, "A wide variety of types of commercial cements is thus included, but the results are so similar in the case of the portland cements that the curves can all be treated alike." His data, presented in graphic form only, do not show any marked differences in the volume change (increase in length, in this work), between the four cements in neat specimens stored in water, until what appears to be 60 days. Then, however, the rate of increase in length appears to be quite different, so that at six months two of the cements had increased in length .075 per cent, the third about .06 per cent, and the fourth .10 per cent. At the end of a year the values are .10, .075, and .15 per cent, respectively. The author apparently intended to indicate in the above quotation only the similarity in trend and not in values in the curves, for it seems that one of the cements in a year had twice the expansion of another. However see White's later paper in the 1928 Proceedings of the American Society for Testing Materials.[5]

Hatt has drawn some relations between the volume changes of neat cements and those of concretes made therefrom in two of his publications.

The reader is referred to Hatt's "Researches in Concrete" for an excellent digest and bibliography of "Expansion and Contraction" of cement and concrete. Fig. 1 is reproduced from Hatt's "Physical and Mechanical Properties of Portland Cements and Concrete" (*Bul.* 24, Eng. Exper. Station, Purdue Univ.), and is illustrative of how cements may differ in their coefficients of dilation during hardening.

Chemical Heat of Setting in Large Masses

The heat generated during setting of concrete has attracted the attention of many for a considerable period of years. Further, those who have studied the question

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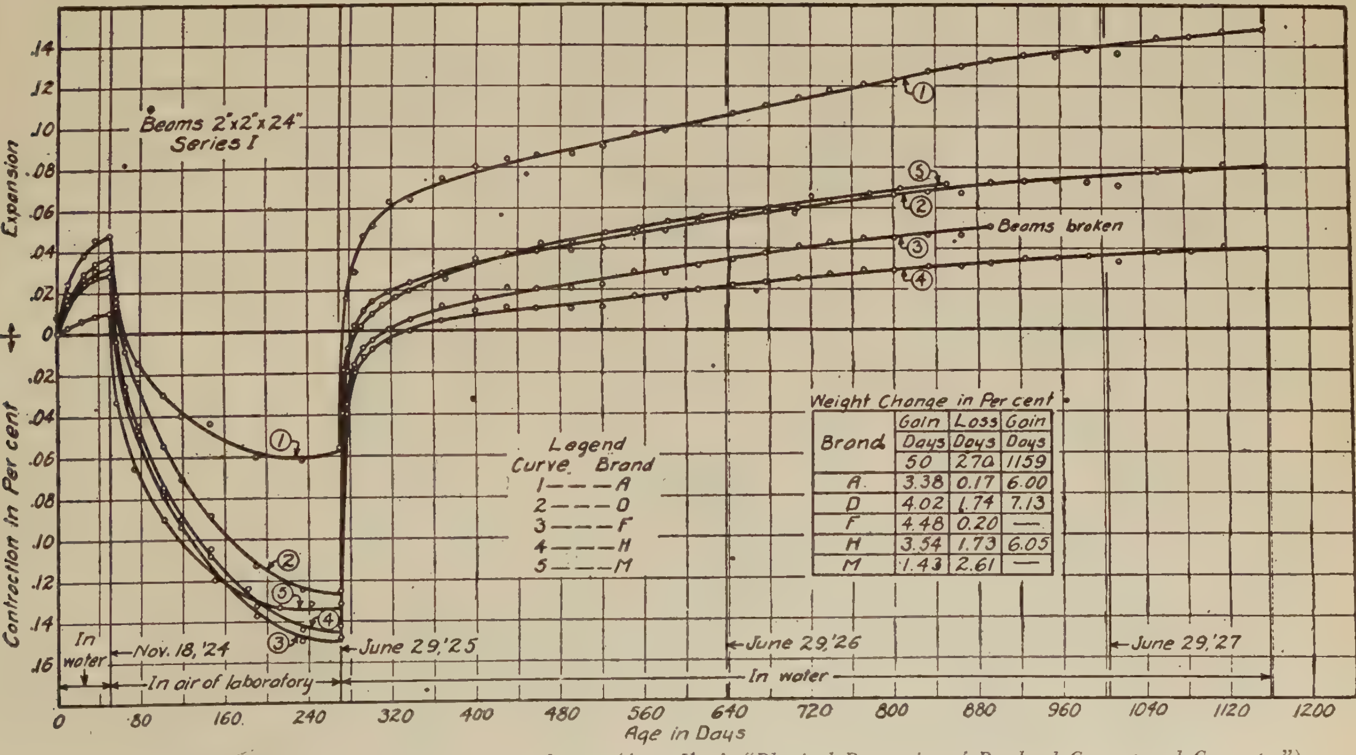
[3] Cement as a factor in workability of concrete: Bates and Dwyer, *Proc.* Amer. Conc. Inst., Vol. XXIV, p. 43 (1928).

[4] Volume changes in portland cement and concrete: White. *Proc.* Amer. Soc. for Testing Materials. Vol. XIV, Part II, p. 204 (1914).

[5] Volume changes of portland cement as affected by chemical composition and ageing: White. *Proc.* Amer. Soc. for Testing Materials, Vol. 28, Part II, p. 398 (1928.)



Weight Change in Per cent

Brand	Gain Days 50	Loss Days 270	Gain Days 1159
A.	3.38	0.17	6.00
D	4.02	1.74	7.13
F	4.48	0.20	—
H	3.54	1.73	6.05
M	1.43	2.61	—

Fig. 1. Expansion and contraction of neat cement beams (from Hatt's "Physical Properties of Portland Cement and Concretes")

have properly connected it with shrinkage, since initially if the concrete has reached a temperature during setting above that of the surrounding atmosphere contraction must result during later cooling, unless the concrete is of the rather unusual yet possible kind that would expand during hardening.

There is possibly no more important phase of concrete investigation neglected at the present time than this one of shrinkage (or volume change) resulting from the heat of the chemical reaction plus that of the surrounding atmosphere. What has been done is strikingly lacking in bearing in mind the many variables. Thus generally in making volume change observations, recourse has not been had to control of temperature or humidity conditions. When this has been done the conditions which might actually exist in practical work have been neglected. Take for instance the studies of volume changes in concrete intended for road making purposes. It has not been possible to find any records where any one permitted test specimens for the purpose in question to set and harden under such conditions of temperature as exist largely in road making.

When control of temperature has been had, it consisted of maintaining the specimens at all times at an "average" or "normal" temperature of about 70 deg. F. But in road making, carried on as it is largely during the summer months, the temperature of the materials and the atmosphere may reach 100 deg. and more before the reaction has proceeded until rigidity of the mass is obtained, the temperature may be 10 to 30 deg. higher. Then in from 6 to 9 months, during the winter, the temperature of the mass will have fallen to possibly below zero. Hence it is not surprising that laboratory results, obtained under such totally different conditions from those existing in the field, do not indicate the cracking of concrete whereas the cracking may actually take place in the field.

There have been some data published from time to time bearing more properly on the subject at hand—the different heats of reaction with water of different cements. The 1901 report of the Waterton Arsenal gives the temperature rise at the center of 12 inch cubes of neat cement made of 13 different cements (natural and portland). Thermometers inserted at the center were used to indicate the temperature. The specimens in board forms and with top exposed to the air were maintained in the air during hardening. The maximum temperature noted was 103.5 deg. C. and the minimum 42.5 deg. C. (for a portland cement). The natural cements developed much lower temperatures.

The data presented in Table 3 through the courtesy of Thaddeus Merriman from unpublished data obtained by him, and that in Fig. 2 from data obtained at the Bureau of Standards, are believe to be as complete and illustrative as any available.

Merriman obtained his data by mixing 450 grams of cement with 112ml of water in a tinned can, three inches in diameter and three inches high. This was placed inside of a specially constructed calorimeter and the temperature of the mixture determined by the use of thermometers read at 15 minute intervals. The heat losses of the

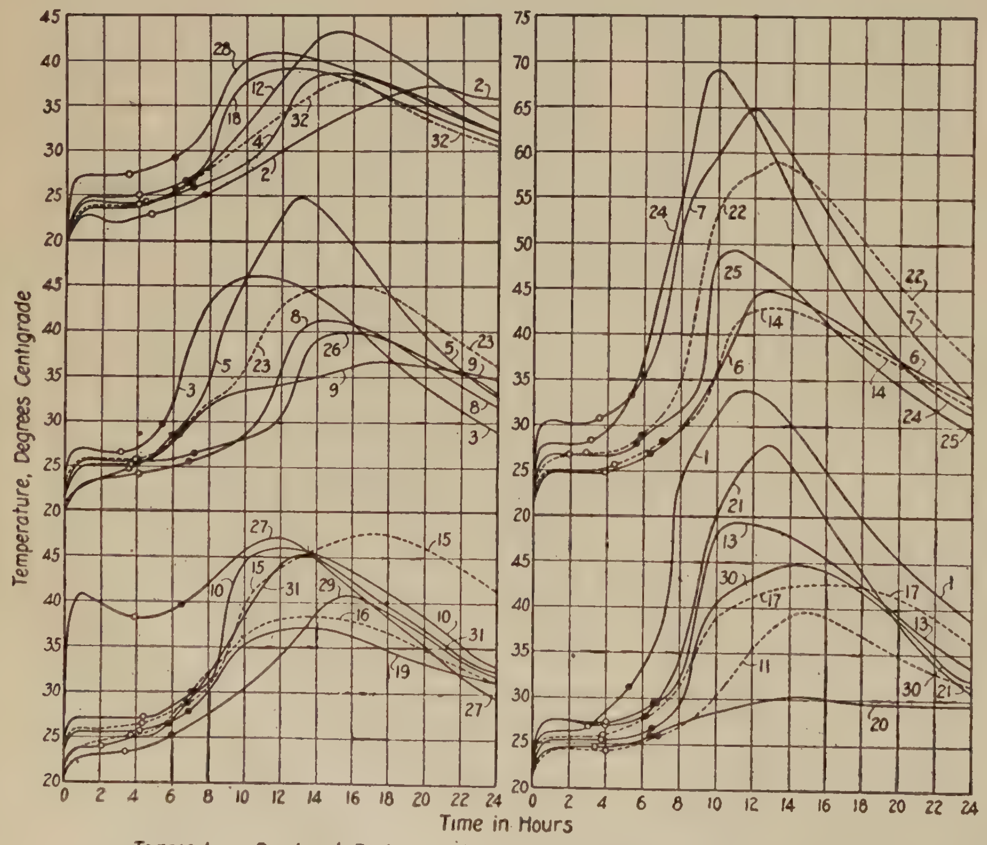


Fig. 2

Temperature Developed During Hardening of 32 Brands of Portland Cement
Average of at least two values obtained by the Bureau of Standards - using 67.5 grams water and 200 grams Cement

Initial set (○) and Final set (●) by Vicat Needle* are the average values obtained by 44 Laboratories using Normal Consistency

*3 Laboratories used Gillmore Needles.

calorimeter were also determined at different temperatures and the temperatures read on the thermometer corrected according to the previously determined heat losses.

At the Bureau of Standards 200 grams of cement were mixed with 67.5 grams of water by a high speed motor-driven stirrer for one minute, in a tinned can 2⅜ inches in diameter and 3 inches high. This was then placed in a thermos jar, closed and placed in a cabinet maintained at 70 deg. F. ± 2 deg. for 24 hours. The temperature was read by multiple junction base metal thermocouples and recorded by a sensitive potentiometer.

The same cements were used by both Merriman and the Bureau of Standards. They are described and their properties given in the report of Committee C-1 of the American Society for Testing Materials to that Society at its 1928 meeting (*Proc.* A. S. T. M. 1928, Part I, p. 233). The numbers used in Fig. 2 and Table III to differentiate the cements are the same as those used in the committee report.

TABLE III

Total Temperature Rise (Degrees F.) of Neat Pastes of Thirty-Two Brands of Cement

(Data supplied by Merriman, Chief Engineer, New York Board of Water Supply)

450 Grams Cement: 112 Grams Water

Cement No.	Rise at 8 Hrs.	Rise at 16 Hrs.	Rise at 24 Hrs.
1	151	196	198
2	38	124	140
3	141	158	158
4	36	138	149
5	119	170	171
6	105	176	184
7	153	171	174
8	98	172	174
9	105	159	159
10	63	138	147
11	84	172	180
12	93	135	151
13	131	180	187
14	85	156	176
15	47	169	171
16	85	171	179
17	90	182	185
18	72	160	172
19	45	142	154
20	40	100	118
21	129	174	177
22	146	205	208
23	95	159	162
24	146	153	153
25	93	141	149
26	33	147	166
27	132	155	156
28	83	121	127
29	96	162	171
30	96	159	159
31	100	142	151
32	65	129	138

In Fig. 2 there is also indicated the time of set. This shows that final set (assuming some rigidity) has taken place before the maximum temperature has been obtained. Both laboratories obtained data which show that there is a marked difference between brands in respect to the property under consideration.

But just how much difference there would be in the deportment of concretes made from these cements can be but a matter of conjecture. It would be reasonable to assume that the concrete would develop about the same relative variation, but it would be most interesting to know definitely whether this would be the case. Such data as these presented merely indicate the need of further study, particularly of concrete so hardened as to acquire temperatures more in accord with those obtained in mass concrete in actual jobs than the usual procedure generally permits.

Reactions to Curing Conditions

In general laboratory procedure, specimens having portland cement as a binder are invariably stored in water or in an atmosphere about saturated with water vapor. Such conditions are fairly readily obtained, but in many localities it is difficult to maintain the temperature throughout the various seasons without an expenditure of money that in many cases seems unjustified. Hence in the great majority of cases no attention is paid towards maintaining a fixed adopted temperature or trying to evaluate properly what has been the effect of a variation from the usual normal temperature of the atmosphere. There have been investigations studying the effect on strength of concrete cured at freezing or slightly higher temperatures, and at temperatures around that of boiling water or somewhat higher, through the use of autoclaves. But when the data are examined it will invariably be found that the cement has not been a variable.

Table IV presents certain data obtained at a cement plant from a number of cements of different composition. All of these met the requirements of the American Society for Testing Materials. In the table only the strengths of 1:2:4 limestone concretes at the ages of 28 days, six months, one year, and five years are given. One set of three 6 by 12 cylinders was stored in the damp closet after 24 hours in the molds, and one set on the roof after the first 24 hours in the molds followed by six days in the damp closet. It will be noted that at 28 days there was not much difference in the strengths as a result of the different storages. With some of the cements one storage gave the higher strengths and with others the opposite was

TABLE IV

1:2:4 limestone concrete made from 15 cements, stored for ages shown in the damp closet (D. C.) or in the air (A) on a roof

Age	Storage	Cement Numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
28 d.	D. C.	3050	2730	2520	2550	2410	2640	2700	2280	2220	2200	2300	1770	1780	1810	1990
	A	2870	2780	2820	2680	2430	2820	2730	1940	2110	2240	2190	1870	1870	1820	1990
6 mo.	D. C.	4120	3500	3680	3710	3770	3500	3680	3710	3770	3710	4080	3600	3710	3460	3350
	A	3620	3700	3460	3090	3160	3690	3460	3090	3160	3100	3160	3060	3250	3100	3150
1 yr.	D. C.	4630	4510	3810	3790	4200	4680	4250	4210	4380	4620	4960	4580	4490	4580	4470
	A	3400	2970	2870	2780	3090	3330	3340	3150	3320	3290	3380	2800	3340	3000	3040
5 yr.	D. C.	5010	4110	3870	4270	4050	4490	4490	4450	4750	4580	4810	5020	5110	4990	4910
	A	4140	3950	3960	3600	3660	4240	4100	3950	4200	3700	4250	4580	4190	4280	4230

noted. At six months the lack of water for further hydration needed for gain in strength by the roof-stored specimens is indicated by the almost general higher strengths and good gain in strengths of the damp closet-stored specimens, compared with the low strengths and lack of gain of the roof-stored specimens. This is very decidedly indicated by the one year specimens. At this age the concrete made from all the cements tested much higher after storage in the damp closet than after storage on the roof. Note also that the roof-stored specimens in the majority of cases showed less strength at one year than at six months. This is evidence not only of lack of hydration but also of drying out to the extent that the bond formed by the cement already reacted upon is losing strength. The six months period between the testing at ages of six months and one year also came at a season of the year of very little precipitation and very low atmospheric humidity.

At five years, however, the two storages are indicating more similar strengths for any cement, the damp closet-stored specimens showing less gain than the air-stored specimens. During the period between the one and five year tests precipitation had caused hydration at a greater rate in the roof-stored specimens than in the damp closet-stored specimens, already more completely hydrated at the end of one year.

Discussion by Thaddeus Merriman

Mr. Bates, as Author-Chairman of Commitee 202, has performed a significant service in the cause of portland cement. His paper points out with singular clearness the vital fact that no two cements are alike in all of their characteristics and, as an inescapable corollary, he shows that cement must be considered as a variable if the results of tests on concrete and mortars are to be intelligently evaluated.

For many years the writer has earnestly sought to present this same aspect of the problem and he therefore heartily concurs with the presentation of the author. Yet he would go further and suggest that a partial remedy for the present uncertain situation as to cement quality is to be found in a specification for portland cement which will relate the strength it develops to its content of lime. An overlimed and underburned cement will show a strength sufficient to pass the ordinary specification. It will make a plastic concrete but, under outdoor exposure, will tend to disintegrate. The plasticity comes from the laitance which is produced by the rapid hydration of the underburned cement particles even before the concrete leaves the mixer. Nobody wants laitance because everybody knows it to be undesirable. Yet many cements now in the market develop laitance in large proportion.

The present specification for cement may be likened to a specification for structural steel which contains no requirement for elongation. Such a specification would be just as one-sided as is the so-called standard for portland cement which, predicated on strength alone, contains no requirement for "completeness of manufacture." But progress in this direction is in sight. The kind of cement needed for use under outdoor and hydraulic exposures is being made and can be had if only the consumer will write his specification accordingly. Recent contracts prepared under the direction of the writer, and calling for 1,500,000 barrels of cement, specify that the tensile strength of mortar briquettes shall not be less than 275 pounds at 7 days and not less than 375 pounds at 28 days. It is also required that the molecular ratio first suggested by Colony[6] shall not exceed 2.60. The alumina is held below 7 per cent, the magnesia below 4 per cent and the sulphuric anhydride below 1.75 per cent. The cement furnished under this specification is of excellent quality. Laitance appears not at all; the compressive strengths are high and the *texture* of the concrete begets confidence because of its firm and rocklike appearance. It is an excellent cement but can be made still better by holding the molecular ratio down to say 2.45.

The time is close at hand when we must put aside the conceptions of cement compounds which have been our guide for some years past. These concepts may ultimately be developed and become of value, but for the present they are not even useful as symbols for pointing the way to progress. Tri-calcium silicate and di-calcium silicate have been the passwords in a large part of the literature on portland cement, yet the existence of these compounds in the cement of commerce has never been conclusively demonstrated. Theoretically it would be of value to know the compounds which are present but practically it makes little difference. We may just as well, for the purpose of discussing the problem, assume that all cement contains four types of compounds and describe each by the characteristics it develops in concrete rather than by its chemical formula. Thus, the existence of the following compounds may be predicated:

Type A—Makes durable and resistant concrete of high strength. Its constituents are closely and intimately combined.

Type B—Makes strong concrete but develops laitance and tends to disintegrate. Its constituents are indifferently combined.

Type C—Makes concrete of fair strength which disintegrates easily. Its constituents are loosely combined and it develops much laitance.

Type D—Develops no strength in concrete and readily disintegrates. Its constituents are only barely combined and it acts merely as an adulterant which makes much laitance.

Each of these types may be further divided but the four enumerated serve to illustrate the principle that all portland cement is a mixture of a number of types of compounds. The proportions of the several types vary in different cements from different mills and often from hour to hour in the same mill. One cement consisting largely of Types A and B is an excellent product. Another contains a little of each of Types A and D and much of Types B and C. It is a medium cement which tends to disintegrate on exposure. A third cement may consist of Types B, C and D, with C predominating; it will show good strength but will quickly disintegrate and will show much laitance. All of these three assumed combinations will pass the usual specification requirements. They sell at the same price, yet they are not of equal value in the concrete they produce. The great need of the engineer is for a test which will enable him to select that cement which is best suited to his work. Such a test, however, will not come to be recognized until both producer and consumer understand that portland cement as produced in the rotary kiln is not a fixed and definite compound, but is, in fact, subject to many variations which, ofttimes, are of great magnitude and are not disclosed by a specification which merely calls for a minimum strength. Under such a specification low grade products are hall-marked as equal to the best. In no other field of material used in engineering structures does such a condition obtain.

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[6] "Judging the Quality of Portland Cement." Trans., Amer. Inst. Mining and Metallurgical Engineers, 1921.

~ EDITORIAL ~

We Know Too Little About Cement

IN all the confusion that has developed in and around the cement industry within the last year or two, one fact stands out clearly—we know too little about cement.

This fact is emphasized in several different ways by P. H. Bates, of the U. S. Bureau of Standards, in his paper on "Variations in Standard Portland Cements," abstracted in this issue. As Mr. Bates points out, there is a surprising lack of laboratory data dealing with the characteristics of different brands of portland cement. Almost without exception, laboratory investigators have not considered the cement as one of the variables, and have passed it by with the usual statement that it complied with the A. S. T. M. specifications. Much of our testing laboratory practice has, in fact, eliminated the possible influence of variations in cements by using a mixture of a number of different brands for experimental work.

The present situation is, in consequence, that we know less about cement than about any of the other ingredients of concrete. The engineer is not supplied with sufficient data to enable him to select the right kind or brand of cement for special kinds of service. He is compelled to depend too much on guess-work, and he may guess wrong. On water-front construction he may use a brand whose characteristics are not suited to that particular service. The structure develops progressive disintegration and another black mark is chalked up against concrete. Yet that same brand of cement might have given perfect service in the general run of structures.

It may as well be recognized that not all brands of cement are alike. In fact samples of the same brand coming from different mills may have characteristics that are quite different. Engineers know these things, and they are waiting for the cement industry to give them the data required as a basis for the selection of the proper cement for special locations.

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Has Cement Been Over-Promoted?

HAS portland cement been over-promoted? Has the use of portland cement concrete been popularized among too many classes of people who know too little about the proper way to make concrete?

It might be well for the cement industry to take a lesson from military strategy. When the invading army has gone forward too far and too rapidly it is spread out too thin. Its flanks are exposed to attack and its communications to the rear may be cut off.

To correct this insecure situation the army consolidates and strengthens its positions, repairs its lines of communication and re-establishes full coordination between the different branches of the service.

In many respects the cement industry is in such a situation. Concrete is a popular material—with most people—but, like the invading army, it is spread out too thin. It is being used for purposes for which, in view of our present knowledge of the material, it may not be wholly suited. It is being used by people who have not been educated up to the methods of using it properly. Every case of disintegration that results from such misuse is a glaring advertisement against concrete.

Cement and concrete may not have been over-promoted, but there is urgent need for a consolidation of positions, for further research and educational work for the benefit of the people who are actually using the material and are trying to use it right.

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Senate and House Near Agreement On Cement Tariff

THE U. S. Senate on March 7th reversed its former action of January 31st by voting a tariff of six cents per hundred pounds on portland cement. The vote of March 7th was 45 to 37 in favor of the tariff, while the previous action taken in January had placed cement back on the free list by a vote of 40 to 35. On March 24th the Senate reaffirmed its action of March 7th by passing its version of the entire tariff bill.

The House bill calls for a tariff of eight cents per hundred pounds on portland cement, indicating that the joint committee which later will adjust differences in the bills offered by the two legislative branches should have little difficulty in reaching an agreement. It now seems reasonably sure that cement manufacturers can make their plans on the assumption that their product will have some tariff protection. While the rate is not high, it will at least offer a small measure of relief from the almost intolerable situation that has prevailed.

It is expected that the joint conference committee of the two houses will begin consideration of the tariff bill about April 1st, and that about six weeks will be required for adjustment of the numerous points of difference in the provisions of the House and Senate bills. If this expectation is realized the bill should be disposed of by the middle of May.

Group of State Plants Suggested for West Virginia

The West Virginia board of control has been asked by the state auditor, Edgar Lawson, to look into the feasibility of establishing cement plants in four or five counties having an abundance of limestone, both as an economical measure and as an outlet for prison labor.

The suggestion followed a prior statement by the secretary of the capitol building commission that he had been informed cement prices had been increased 25 cents per bag in the state recently.

"Not only would this plan save tens of thousands of dollars annually to the state," the auditor wrote, "but it would provide an outlet for congested conditions at the state prison at Moundsville by using convicts in the labor necessary at the cement plants.

"It is estimated that in the neighborhood of 50,000 bags of cement will be used in the new capitol and between 100,000 and 150,000 will be used this year by the state road commission in the construction of our public highways. Based on the 25 cents per bag increase alone, this would mean a saving of at least $50,000, and with prison labor employed, it is my opinion that between $50,000 and $75,000 could be saved the taxpayers, inasmuch as the cost of production would be substantially curtailed.

"I am fully aware that the cry will go up that West Virginia should not enter into trade competition, but I believe the facts in this instance justify the ends. Whenever any corporation, whether it be a cement manufacturing one or otherwise, enjoys what practically amounts to a monopoly, and apparently knowing that the state would require large supplies of its products, orders a substantial increase in the price of its product overnight. I believe the state is justified in using whatever means are at its disposal to cope with the situation.

"To my mind, however, the humanitarian aspect is of far more importance than the money the state will save by manufacturing cement at cost. The average prison population turnover is about three years, so one can readily see that the majority of the convicts are short-termers."

Florida Plant Operates at Full Capacity to Supply Demand

Full capacity production, for the first time in its two and a half years of operation, was inaugurated at the Florida Portland Cement Company plant at Tampa, Florida, on March 3rd.

With the peak capacity of the plant fixed at 1,650,000 barrels a year, it will be operated at a full speed rate to maintain a production of 412,500 barrels during the first quarter to fill orders already on the books.

A group of officials, including John L. Senior, of Chicago, president, and S. W. Storey, Chicago, vice president, visited the plant on March 3rd. All were optimistic over the manner in which the Florida-made cement is rapidly increasing in demand by dealers, contractors, engineers and state, county and city engineering departments.

They pointed out that the maintenance of peak production at the plant also brings a subsequent increase in employment at both the local plant and the company's quarries at Brooksville, adding that a full quota of workers has been taken on at both points. Under the new operation schedule put into effect, shipment of raw materials from the company's Brooksville quarries to Tampa is increased to 150 cars of rock and 50 cars of clay a week while incoming steamers discharge a solid shipload at the coal dock every 10 days.

The company has recently spent $80,000 in increasing its private water-front docking facilities and dredging around 800 feet of its 1300-foot wharf frontage. Further improvement will be made, officials explained, to facilitate the handling of its increasing water bound commerce, which is one of the largest businesses handled in this port. Records show that the company's water commerce has more than trebled since the plant was opened. The company's water bound commerce, including incoming and outgoing cargoes during 1927, totaled 19,341 tons as compared with 38,910 tons for 1928 and 77,903 tons for last year.

Alpha Net Income Shows Deficit of $500,000 After Dividends

The Alpha Portland Cement Co. reports for the year ended December 31, 1929, consolidated net income of $1,815,018 after depreciation, federal taxes, etc., equivalent, after dividends on 7 per cent preferred stock, to $2.35 a share on 711,000 no-par common shares.

Consolidated income account for year ended December 31, 1929, follows: Net sales $11,368,968; expenses $8,336,699; operating profit $3,032,269; other income $307,297; total income $3,339,566; depreciation $1,299,548; federal taxes $225,000; net income $1,815,018; preferred dividends $140,000; common dividends $2,133,000; deficit $457,982.

Decline in Lawrence Earnings for 1929

The Lawrence Portland Cement Company, Siegfried, Pa., reports for the year ended December 31, 1929, a net income after all charges, including depreciation and taxes, of $476,725, equivalent to $6.36 a share on 75,000 shares.

This compares with the 1928 net after similar charges of $721,720, equivalent to $9.62 a share.

Huron to Build Warehouse at Toledo

The Huron Portland Cement Company has received a building permit to construct an $84,000 warehouse on a site recently acquired at Toledo, Ohio. The construction contract has been awarded the Burrell Engineering and Construction Co. of Chicago.

The Peerless Egyptian Cement Co. is said to be considering the erection of a like structure at Toledo.

Michigan State Plant Closes for Two Months

A 60-day suspension of operations at the state cement plant at Chelsea, Michigan, went into effect on February 28th. Storage bins were filled to capacity at that time and reopening awaits the start of highway construction. Repairs are under way during the shutdown.

Correction

The first paragraph under the subhead, "Effect of Disc Installation," Page 110, March issue, in the article entitled, "Filters in Wet Process Cement Plants Save Fuel" should have read:

"The disc filter removed more than one-half of the water in the slurry and produced a cake which proved an ideal feed for the kiln, eliminating the mud rings entirely. It further permitted continuous kiln operation and resulted in greatly increased clinker production at a much lower coal consumption."

Calcium Dusts Increase Lost Time Disability

Recent Report Shows Tendency to Minor Respiratory Trouble, Diseases of Skin, Eyes and Ears, Rheumatism and Impairment of Digestive System—No Tendency to Pulmonary Tuberculosis or Pneumonia — Comparisons With Other Industries

THE *Journal of Industrial Hygiene* (Boston and London) is publishing a series of studies undertaken by the United States Public Health Service to determine the effect of dust on the health of industrial workers employed in the so-called dusty trades.

The first of the series, by L. R. Thompson, M. D., surgeon, United States Public Health Service, and Dean K. Brundage, A. B., assistant statistician, United States Public Health Service, published in the June (1929) issue of the journal, deals with studies of a dry process portland cement plant. This plant was selected as being representative of that group of industries in which workers are exposed to calcium dust.

Detailed analysis of the records collected at the plant indicate that exposure to the quantities of calcium dust generated in this particular mill appear to predispose the workers to certain diseases of the respiratory system, to diseases of the skin and eyes, to deafness, and possibly is a factor in the high rate of digestive illnesses occurring in the finishing end of the mill.

The calcium dust generated in the dry process manufacture of portland cement usually contains a small percentage of uncombined silica. This fact is of especial interest from the hygienic standpoint because calcium in the form of lime is supposed to possess properties which may retard the development of pulmonary tuberculosis, while silica in the free state may cause silicosis and predispose the worker to pulmonary tuberculosis.

The Scope of the Studies

The studies were conducted over a period of nearly three years. Almost every person on the company's payroll was given at least one thorough examination, and a considerable number underwent two such examinations. In addition, persons suspected of having chronic respiratory diseases were given special chest examinations in order to make the diagnosis more definite. X-ray films were taken of the chests of persons employed in different departments of the plant, and the number of dust particles per cubic foot of air was determined in these departments. The dust was weighed, after which it was examined chemically and petrographically. A record was kept of all absences from work, and employes who were absent more than two consecutive days were visited by a nurse for the purpose of obtaining the diagnosis.

Dust Particles Per Cubic Foot

The number of dust particles per cubic foot of air varied from 40,000 to several million in the least dusty department, and from 1,000,000 to 105,000,000 in the department where the dust was heaviest. Wide variations were observed in the amount of dust at any one place, the actual amount of dust depending in considerable part on the direction and velocity of the wind. Table 1 shows the lowest, the highest, and the average number of dust particles less than 10 microns in length, per cubic foot of air, in the various departments.

TABLE 1

Dust Counts at Different Points in Plant

	No. of dust particles less than 10 microns in length, per cu. ft. of air		
Department	Lowest	Highest	Average
Quarry	1,415,000	24,709,000	10,107,000
Stone house	4,508,000	68,605,000	25,271,000
Raw mill	560,000	105,630,000	28,374,000
Coal house	1,146,000	9,260,000	4,057,000
Kiln room	7,089,000	22,000,000	11,298,000
Finishing mill	6,291,000	75,335,000	25,594,000
Bag house	7,740,000	57,296,000	20,563,000
Packing house	16,836,000	69,239,000	29,423,000
Yard	337,000	19,600,000	5,592,000
Physical testing laboratory	14,518,000	22,668,000	18,593,000
Chemical testing laboratory			2,700,000
Indoor air of office 2 miles away	351,000	430,000	390,500

Chemical Analysis of Cement Dust

The chemical analysis of the cement produced at this plant indicated about the usual quantities of the various constituents. The calcium oxide ran about 60 per cent, in round numbers, and the silica about 20 per cent. Iron and aluminum oxides, magnesium oxide and calcium sulphate were present in about the usual quantities.

The question of particular concern, in this investigation, however, was not the chemical analysis of the commercial product, but the chemical analysis of the dust particles floating in the air. As might be expected, the dust in the finishing mill, in the bag house and in the packing house showed practically the same chemical composition as the sacked cement. In departments in the earlier stages of the manufacturing process the dust particles contained less lime and less silica, roughly the same percentages of iron, aluminum and magnesium oxides, no calcium sulphate, and much more of the miscellaneous constituents such as carbon dioxide, water and organic matter. The chemical analysis of the dust particles in the seven departments where the dust was most pronounced is shown in Table 2.

Uncombined Silica in Dust

The proportion of uncombined silica (in the form of quartz) was about 6.5 per cent in the crusher houses, the

TABLE 2

Chemical Composition of Dust Breathed by Workers in Departments Specified

	Crusher Houses	Stone House	Raw Mill	Kiln Room	Finishing Mill	Bag House	Packing House
Silica (SiO_2)*	15.70	17.80	17.00	15.00	18.00	21.30	21.20
Iron and aluminum oxides (combined)	6.20	9.10	7.10	4.20	7.30	7.50	8.40
Lime (CaO)	41.93	36.11	37.71	38.11	60.18	54.56	60.88
Magnesium oxide (MgO)	2.64	2.46	2.17	2.06	2.61	2.68	2.97
Calcium sulphate (expressed as SO_3)	------	------	-----	*	4.08	2.18	1.75
Loss on ignition (carbon dioxide, water, organic matter)	33.45	34.30	36.02	40.40	7.90	11.70	4.75
Totals	99.92	99.77	100.00	99.77	100.07	99.92	99.95

*The proportion of uncombined silica (in the form of quartz) was about 6.5 per cent in the crusher houses, the stone house and the raw mill, and about 1 per cent in the remaining departments.

stone house and the raw mill. During the process of burning in the kilns much of the free silica combined with the various chemical elements in the raw material to form silicates, leaving only about 1 per cent of free silica in the dust of the finishing and packing departments.

Comparison With Other Industries

The disabling sickness rate at this plant (cases lasting two consecutive working days or longer) was compared with similar records of the male employees of eleven manufacturing establishments in various other industries, all located in a general way in the same geographical area. None of these eleven establishments had as much respiratory disability to contend with as was recorded at this cement plant. In fact, the worst case among the eleven plants in other industries was 36 per cent below the rate for the cement plant.

Frequency of Disabling Diseases

The frequency of disabling sickness at this cement plant is compared in Table 3 with the record of the men on the factory payroll of a rubber company. The diseases are listed in the table in the order of the frequency of their occurrence among the cement workers as compared with their occurrence among the rubber company's factory employees.

TABLE 3

Frequency of Disabling Diseases Among Cement Mill and Rubber Workers, Per 1,000 Employees

Disabling diseases (2 or more consecutive days)	Annual number of absences per 1,000 employees: Cement Workers	Rubber Workers	Ratio of cement worker cases to rubber worker cases
1. Bronchitis	50	8	6.25
2. Diseases of the skin	49	9	5.44
3. Influenza and grip	206	63	3.27
4. Diseases of the eyes and ears	16	5	3.20
5. Diseases of the pharynx and tonsils	75	25	3.00
6. Rheumatism, acute and chronic	34	12	2.83
7. Diseases of the digestive system	114	46	2.48
8. Diseases of the nasal fossae	94	54	1.74
9. Other respiratory diseases†	10	12	0.83
Ill-defined and unknown diagnoses	9	38	0.24
All other diseases and conditions	68	46	1.48
Total disability, not including accidents and alcoholism	725	318	2.28

†Includes three cases of pneumonia and one pulmonary tuberculosis case among the cement workers.

TABLE 4

Frequency of Disabling Diseases Among Cement Mill Workers and Among Males of Age 17-64 in General Population of City, Per 1,000 Men

Disabling diseases (2 or more consecutive days)	Annual number of absences per 1,000 men: Cement Workers	General population of city	Ratio of cement worker cases to cases among men in general population of city
1. Diseases of the skin	49	7	7.00
2. Diseases of the digestive system	114	34	3.35
3. Diseases of the eyes and ears	16	5	3.20
4. Diseases of the pharynx and tonsils	75	24	3.13
5. Rheumatism, acute and chronic	34	11	3.09
6. Diseases of the nasal fossae	94	34	2.76
7. Bronchitis	50	24	2.08
8. Influenza and grip	206	108	1.91
9. Other respiratory diseases	10	10	1.00
Ill-defined and unknown diagnoses	9	3	3.00
All other diseases	68	31	2.19
Total disability, not including accidents and alcoholism	725	291	2.49

There were approximately twice as many respiratory cases which caused disability for more than one week among the cement workers as were to be expected from the experience of male members of industrial sick benefit associations which report their cases of sickness periodically to the United States Public Health Service. Influenza, or grip, was the chief cause of the larger number of disabilities in the cement group lasting eight days or longer.

Comparison With Population of City

Corroboration of the data obtained from the comparison with the rubber company's factory workers is found in the check-up on males between the ages of 17 and 64 years, in the general population of the city on the outskirts of which the cement plant is located. Knowledge of the sickness of about one-third of the general population in this city of 30,000 inhabitants was obtained through house-to-house canvasses at intervals of six to eight weeks. There is reason to believe that the information thus obtained is fairly accurate. At any rate, the results were about the same as shown in the comparison with the male factory employees of the rubber company.

The comparison with the males in the general population of the city is shown in Table 4. Reference to Table 4 and Table 3 discloses that the same diseases appear conspicuous among the cement employees in each case, and to just about the same degree.

Further Corroboration

Virtually the same diseases that occurred at comparatively high rates among the employees of this cement mill also showed higher incidence rates among the cement and lime workers of Leipzig, Germany, than among employees in the relatively non-dusty trades in the same city. The Leipzig investigation was extended over a period of 18 years, from 1887 to 1905.

No Tendency to Tuberculosis

A gratifying fact disclosed by the investigation at this American cement mill is the absence of a tendency toward tuberculosis and other pulmonary diseases. Tables 3 and 4 show that the diseases grouped under the heading of "Other respiratory diseases" were few in number and that the rate of occurrence per thousand men was the same among cement workers as among the general male population of the city, and actually lower than among rubber workers. The diseases grouped under the heading of "Other respiratory diseases" include pulmonary tuberculosis, pneumonia, pleurisy, pulmonary emphysema and asthma. As indicated in the footnote under Table 3, only one case of pulmonary tuberculosis and three cases of pneumonia were found among the cement mill workers in the 3-year period of the investigation. Thus it appears that the more serious respiratory diseases are not induced by cement mill dust.

Trouble Is In Upper Respiratory Tract

It is in the minor respiratory diseases, located in the upper respiratory tract, and with certain non-respiratory diseases, that the greatest frequency occurs. These non-respiratory diseases, as shown in Tables 3 and 4, include diseases of the skin, eyes and ears, rheumatism, and impairment of the digestive system.

Hygenic Measures Recommended

The authors recognize the difficulties involved in attempting to control the amount of dust in a dry process portland cement plant, on account of the wide variations in the dust content of the air and differences in the extent to which workers at the plant are actually exposed to the heavier concentrations of dust.

The conclusion is reached that when the dust in the atmosphere is less than about 10,000,000 particles per cubic foot of air, it is doubtful that even the minor respiratory diseases would be found at greater than average frequency.

The authors mention that several cement companies have made notable progress in the development and installation of ventilating devices to control the dust.

For those plants in which it is not practicable to install dust-collecting systems, the authors suggest that the effect of heavy dust concentrations may be minimized through greater care in hiring and placing workers. This suggestion has constructive possibilities, for the investigation disclosed that among the individual workers at the plant who are exposed to the heavy concentrations of dust, the frequency of respiratory diseases varies inversely with the air capacity of the worker's lungs. Conversely, when exposure either to inclement weather or to sudden changes in atmospheric conditions was involved, persons of largest lung capacity showed the most respiratory disability. These facts suggest to the authors the probability that, in the hiring and placing of workers in a dry-process cement plant, men with small lung capacity should not be employed in a dusty atmosphere, especially when under 25 years of age.

Penn-Dixie to Expend $175,000 in Improvements and Additions

Improvements and the addition of two new buildings to the Pennsylvania-Dixie Cement Corporation plant near Valley Junction, Iowa, to cost $175,000 will be started in the near future and completed within 75 days.

The Burrell Engineering and Construction Co. of Chicago has been awarded the contract for a four-story structure 40 by 82 ft. and a one-story building 120 ft. long by 80 ft. high.

The four-story building will be used for packing cement in barrels preparatory to shipping and for handling sacks. The one-story building is for cement storage and will double the storage capacity of the corporation.

E. Grothe of Chicago, who is the engineer in charge of the improvements, is working with Karl Kastberg, the corporation's local engineer. It is planned to work twenty-four hours a day on the buildings and have them completed in seventy-five days. Construction will be of concrete.

The plant, shut down recently, was to begin operation on a full time basis on April 1st.

Production Ceases for Short Time at Illinois Plant of Medusa

The Dixon, Illinois, plant of the Medusa Cement Company was closed down on February 17th for the annual overhauling.

An outstanding part of the spring overhauling program will be the hooking-up of the 300-foot stack which was completed early in the winter. According to General Superintendent White, the stack is the largest of any at the Medusa company's plants and ranks among the largest in the cement industry in the country. In discussing plans for the future of the Dixon plant, the general superintendent said:

"We have by no means completed our program of improvement of the Dixon plant and there remains a great deal more work before the work will be completed. Improvements which have been made in rebuilding and installing new machinery during the last two years have increased the output of the Dixon mills about 50 per cent and the plant is now able to turn out 5,000 barrels of cement daily."

Pacific Portland Common Stock Earnings

The Pacific Portland Cement Company, San Francisco, California, reports that for the year ended December 31, net profits were equal, after preferred dividends to $5 a share on 82,500 shares of $100 par value common stock outstanding.

Cement Making from Waste Materials

Industrial Wastes and By-Products That Can Be Used as Raw Materials in Cement Manufacture

By E. T. ELLIS, F.J.I.

In this contribution attention is focused mainly on the utilization of waste materials produced by the manipulation of organic compounds.

The relation between the chemistry of the carbon compounds and the chemistry of cement manufacture may not at first be apparent, but over and over again the so-called troublesome by-products produced in the manufacture of much-wanted organic compounds can be made use of as raw materials for cement.

The use of industrial waste materials as the raw material for the manufacture of cement has not been developed to a degree even approaching its ultimate possibilities.

Carbonate Cement from Oil of Bitter Almonds

MOST cement makers may be more or less familiar with benzoic aldehyde, the popular name of which is oil of bitter almonds. This organic compound is of great importance, and it is likely to be manufactured on a much larger scale in the future than it has been in the past.

One of the ways of preparing it is by submitting a mixture of benzoate and formate of calcium to distillation. If this is carried out properly the two organic calcium salts are completely decomposed with the production of oil of bitter almonds as the main product, and a residue consisting exclusively of calcium carbonate.

Bearing in mind the fact that benzoic aldehyde boils at a comparatively low temperature (under 180 degrees Centigrade), its complete removal from the carbonate is very easy. Owing to the fact that it is not easily soluble in water traces of the liquid cannot be removed rapidly by washing the carbonate. Very pure samples are, however, obtained by carrying out the distillation completely, and the residual carbonate is then worked up into calcareous cement in the usual way.

Cement Chalk from the Acetone Industry

Cement manufacturers should next turn their attention to the acetone industry. This again is likely to be developed in the future even more than it has been in the past, on account of new uses for this chemical coming to light.

Acetone, which is also known to chemists by the names of propanone and dimethylketone, is again preparable from a calcium organic salt. Thus if calcium acetate is submitted to distillation it is decomposed. Acetone is the organic derivative produced, and the residue again consists of comparatively pure calcium carbonate.

Acetone like oil of bitter almonds is a liquid, but it boils at a much lower temperature (under 60 degrees Centigrade). It is easy, therefore, by carrying out distillation completely to remove it from the carbonate, and analysis of the residue should not show any traces either of undecomposed calcium acetate.

The resulting chalk does not call for much in the way of purification, and many authorities agree that it can be worked up with clay and other cement raw products directly.

Chalk for Cement from Ferrocyanide Factories

Another chemical with which most cement manufacturers will be familiar is potassium ferrocyanide. In the manufacture, a considerable quantity of chalk (calcium carbonate) is usually obtained, but as far as I have been able to gather this is only employed in the manufacture of cement to a very limited extent at the present time.

In the preparation of potassium ferrocyanide it is usually more convenient first of all to produce calcium ferrocyanide for technical reasons into which I need not enter here. Calcium ferrocyanide dissolves in water, and on the addition of a solution of potassium carbonate to this, double decomposition, of course, ensues, insoluble chalk being precipitated which can be filtered off, while potassium ferrocyanide remains in solution.

After filtering off the insoluble calcium carbonate, cement manufacturers should proceed to wash it very thoroughly. Unless this is done it is almost certain to give unsatisfactory results, owing to the fact that it may be largely contaminated both with potassium carbonate and undecomposed calcium ferrocyanide.

When the washing is complete, provided, of course, that this is done with distilled water, the wash waters should give no reaction with any of the commoner reagents owing to the fact that calcium carbonate is practically insoluble in water. After washing, this by-product is then carefully dried, ground if necessary, and then mixed with clay, etc., and worked up in the usual manner.

Other Organic Compounds Yielding Cement Makers' Chalk

I should like to call special attention to two other organic compounds in the production of which considerable quantities of valuable calcium carbonate are obtained. These are benzophenone and anthraquinone respectively.

A cheap way of obtaining benzophenone, which by the way is also called diphenylketone, is to submit calcium benzoate to distillation. When this is properly carried out the salt breaks down into benzophenone and calcium carbonate.

Here again the chalk which is obtained is found to be in a state of very fair purity, and though traces of calcium benzoate may be present if the process is manipulated in a faulty manner, these can be easily removed by re-distilling the waste.

Anthraquinone is, as cement makers will probably be aware, an organic chemical of enormous importance, mostly on account of the fact that valuable dyestuffs are easily obtainable from its derivatives. Its manufacture is, therefore, likely to be greatly extended in the near future, and one of the easy ways of preparing it is to submit calcium phthalate to distillation. When this is done the salt breaks down, anthraquinone being the organic derivative and calcium carbonate the inorganic one.

Some authorities recommend the residual chalk being well washed with water prior to its being worked up in the manufacture of cement, but they appear to have overlooked the fact that anthraquinone does not dissolve in water, and hence it cannot be removed from cement making chalk by this means. Traces can be removed if their presence has been definitely proved by treating the chalk with alcohol and ether if desired, but the more usual method of purification is to heat the chalk strongly in order to sublime any traces of anthraquinone which may be mixed with it. This can easily be done, as solid anthraquinone melts and sublimes at a comparatively low temperature.

Some Further Useful Inorganic Sources

Finally, while space does not permit of their being discussed, it may be interesting to mention four further inorganic sources of cement making materials in which waste products are largely or exclusively employed.

First of all magnesia cement can be obtained with very fair ease from the waste salts or the waste liquids of the Stassfurt potash deposits, and if cement makers find out that the raw salts are being imported and manipulated within easy reach of their own works they should give the exploitation of the residues more than passing consideration.

Secondly, copperas crystals from the galvanizing and tinplate industries are, after being calcined in order to recover the sulphuric acid, a valuable source of iron cements, the iron oxide which results from such treatment being comparatively readily worked up.

Thirdly, various alum cements can be obtained very cheaply and easily by the manipulation of waste of several metal extracting operations. The main principle of these consists of the ignition of a metallic oxide with aluminium powder, whereby the metal is released and oxide of aluminium remains.

Fourthly and finally, calcium carbonate for cement production is a very bulky and often exceedingly troublesome by-product in the manufacture of borax, and where this industry is operated in the vicinity of cement mills full use should be made of the cheap residue which is available in regular quantities all the year round.

In the majority of cases firms producing calcium carbonate or other cement making materials as by-products have not the time to work them up in their own factories, although numerous outlets have been suggested from year to year. Thus there is no fear of the manufacturer of potassium ferrocyanide becoming a competitor of the cement miller for instance, while it is extremely unlikely also that the galvanizer or tinplate worker will decide to produce cement at one end of his works, while sheets of finished metal are issuing from the other.

A Novel Heat-Saving System Developed in Scotland

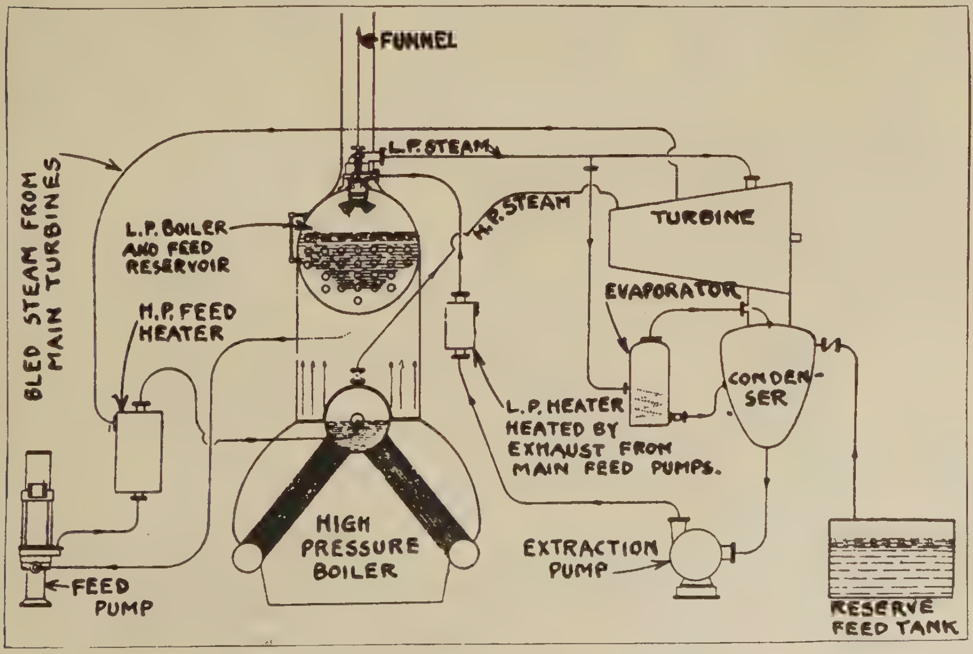
Engineers are interested in the new power plant system developed by G. & J. Weir of Glasgow, Scotland. A diagrammatic arrangement is shown. In this system, a low pressure boiler is placed in the uptake of the main boiler.

The high pressure steam passes into the high pressure end of the steam turbine while the low pressure steam may enter the turbine at about atmospheric pressure, or even lower and is utilized in the low pressure stages. The arrangement of feeding, feed heating, extraction, and everything else, are carefully worked out.

This system has the following advantages:

1. The low-pressure boiler acts as a feed-heater, a steam generator, and a feed reservoir in one.
2. A closed and de-aerated feed system is obtained.
3. The heat-absorbing capacity of the low pressure boiler is not limited to feed-heating.
4. Main boiler can be forced without serious loss. Extra load taken by low pressure boiler.
5. The absorption of auxiliary exhaust steam in the feed water is made possible to the fullest extent.
6. The whole feed system is under low pressure.
7. No brickwork, hence minimum weight and leakage.

While a system of this sort is of less advantage to plants where low pressure steam is usable in processing work, it will nevertheless be of interest and possibly of value toward encouraging greater economy even in such plants.



Cement Statistics for February

February Cement Production Lower—Shipments Increased by One-Fourth—Stocks and Production to Date Lower

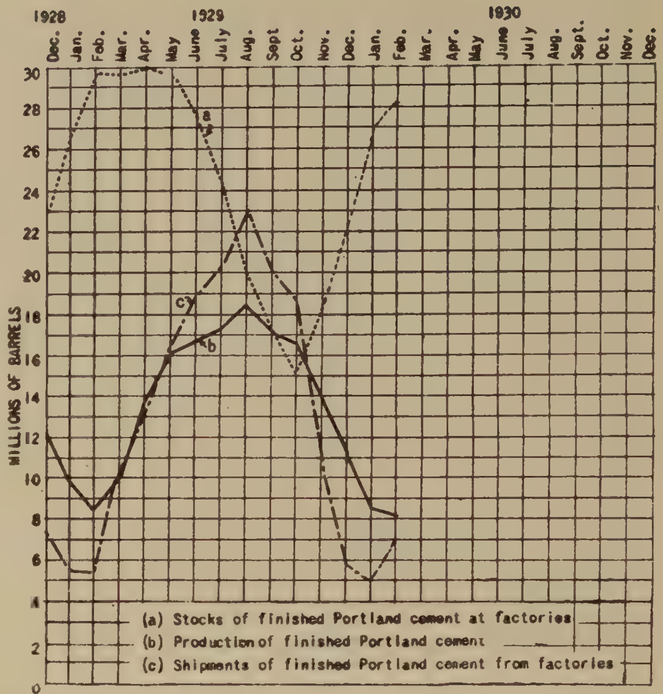
Relation of Production to Capacity

(Figures represent per cent)

NOTE: IN ORDER THAT THE READER MAY KNOW THE TREND AT A GLANCE, THE HIGHER FIGURE, WHETHER FOR EITHER YEAR, UNDER ANY CLASSIFICATION, APPEARS IN SLIGHTLY HEAVIER TYPE.

	—February—		Jan.	Dec.	Nov.
	1929	1930	1930	1929	1929
The month	**44.8**	41.5	38.8	51.5	66.6
The 12 months ended	**71.0**	65.6	65.5	66.4	66.8

	1929	1930	Increase or Decrease (—) Per Cent
Production, February	**8,522,000**	8,162,000	—4.2
Shipments, February	5 448,000	**7,012,000**	28.7
Stocks at end of February	**29,870,000**	28,231,000	—5.5
Total production for year to date	**18,403,000**	16,660,000	—9.4
Total shipments for year to date	11,155,000	**11,967,000**	7.3
No. of plants reporting	160	**165**	



Production, Shipments and Stocks of Finished Portland Cement, by Districts, in February, 1929 and 1930, and Stocks in January, 1930

District	Production—February		Shipments—February		Stocks at end of month		Stocks at end of January, 1930*
	1929	1930	1929	1930	1929	1930	
Eastern Pa., N. J. and Md.	**2,199,000**	2,033,000	1,354,000	**1,419,000**	**6,933,000**	6,689,000	6,075,000
New York and Maine	**412,000**	187,000	232,000	**257,000**	**1,984,000**	1,545.000	1.615,000
Ohio, Western Pa., and W. Va.	**829,000**	762,000	442,000	**651,000**	**3.611,000**	3,401,000	3.289,000
Michigan	525,000	**543,000**	**302,000**	297,000	2,658,000	**2.754,000**	2,509,000
Wis., Ill., Ind., and Ky.	862,000	**883,000**	373 000	**664,000**	3,911,000	**4,145,000**	3,926,000
Va., Tenn., Ala., Ga., Fla., and La.	**887,000**	727,000	662,000	**881,000**	**2,180,000**	1.598,000	1,753,000
Eastern Mo., Ia., Minn., and S. Dak.	678,000	**748,000**	215,000	**492,000**	**4.353,000**	3,396,000	3,140,000
W. Mo., Neb., Kans., Okla., and Ark.	482,000	**709,000**	311,000	**764,000**	1,782,000	**1.834,000**	1,889,000
Texas	399.000	**482,000**	416,000	**521,000**	513,000	**779,000**	817,000
Colo., Mont., Utah, Wyo. and Idaho	74,000	**130,000**	57,000	**104,000**	**541,000**	441,000	415,000
California	**1,071,000**	755,000	**984,000**	793,000	871,000	**1,130.000**	1,168,000
Oregon and Washington	104,000	**203,000**	100 000	**169,000**	**533,000**	519.000	485,000
	8,522,000	8,162,000	5,448.000	**7,012,000**	**29,870,000**	28,231,000	27,081,000

Production, Shipments and Stocks of Finished Portland Cement, by Months, in 1929 and 1930

Month	1929—Production—1930		1929—Shipments—1930		Stocks at end of month	
					1929	1930
January	**9,881,000**	8,498,000	**5,707,000**	4,955.000	26,797,000	***27,081,000**
February	**8,522,000**	8,162,000	5,448,000	**7,012,000**	**29,870,000**	28.231.000
March	9,969.000		10,113,000		29,724,000	
April	13,750.000		13,325,000		30,151,000	
May	16.151.000		16,706.000		29,624 000	
June	16,803,000		18,949,000		27,505,000	
July	17,315,000		20,319,000		24,525,000	
August	18.585,000		23,052,000		20,056,000	
September	17,223.000		19,950,000		17,325,000	
October	16,731,000		18 695,000		15,381,000	
November	14 053,000		11,222,000		18,213.000	
December	11,215,000		5,951,000		23,550,000	
	170,198,000		169,437,000			

*Revised.

MEN and MILLS

Notes from the Field

Lone Star Employees Receive 1929 Safety Checks

The quarry department was in charge of the safety meeting held at the plant of the Lone Star Cement Company, New York Incorporated, at Greenport, near Hudson, New York, on February 11th. Each month a different department handles the meeting. Charles Kayser was in charge and handed the meeting over to Thomas Russell.

Musical numbers, a safety skit and a talk on blasting caps by Mr. Kayser were included on the program. At the conclusion of the meeting, the annual cash safety awards were made to plant employes who had been free from any lost time accidents during the past year. Many were included in this category, the checks in the aggregate amounting to several thousand dollars.

Schmidt Leaves Lehigh to Join Davison Coke

Nelson S. Schmidt has joined the Davison Coke and Iron Company, Pittsburgh, Pa., in the capacity of superintendent of the firm's cement plant at Neville Island, Pa., near Pittsburgh.

Mr. Schmidt was formerly superintendent at Newcastle Plants No. 1 and 2 of the Lehigh Portland Cement Company.

Universal Atlas Leases Space for Overflow Activities

The Universal Atlas Portland Cement Company, Chicago, Illinois, has leased 5,600 sq. ft. of space in the Adams-Franklin building to house overflow activities from the main headquarters, located in La Salle Street, Chicago.

Barbazette, Alpha Divisional Manager, Dies

J. Harry Barbazette, manager of operations in charge of the western division mills of the Alpha Portland Cement Company, passed away on March 4th.

He was a graduate of the Rose Polytechnic Institute.

In January, 1909, he joined the Universal Portland Cement Company as superintendent of construction of their plant No. 6 at Buffington, Ind. Four years later he was sent to Duluth, Minn., as superintendent of the Universal's plant at that point. Following this connection, he was employed by the Mid-West Credit and Statistical Bureau for several years, leaving to take the post of assistant sales manager of the Lehigh Portland Cement Company, Chicago, which he held until March, 1920. Mr. Barbazette then went with the Alpha Portland Cement Company, where he soon was promoted to the important position he held until his death. He held appointments on several important committees of the Portland Cement Association, one of which was the committee on papers for mill sessions.

Lone Star Sends Eight to Safety Meeting

Eight delegates represented the Lone Star Cement Co., Indiana, Inc., at the regional safety meeting held at Cincinnati, Ohio, on February 11th. They were as follows: John O'Callaghan, Albert Shuey, Raymond Baldwin, Edwin Rogers, Otto Carty, William Huber, Russell Fuller and Hugh Walker.

Kroll Resigns as General Manager of Hudson, N. Y., Plant

A. G. Kroll, of Allentown, has resigned his position as general manager of the Universal Atlas Portland Cement Company plant at Hudson, New York. He had held the position since the establishment of the plant there.

Jas. O'Donnell, Foreman at Atlas Mill 4, Dies

Jas. J. O'Donnell, for twenty-eight years, foreman of Mill No. 4, of the Universal Atlas Portland Cement Company plant at Northampton, Pa., died on February 28th.

Mr. O'Donnell was one of the first men to be hired by Atlas when operations were begun in that locality.

Myram Hammond, Great Lakes Vice-President, Dies

The death of Myram Hance Hammond, vice-president of the Great Lakes Portland Cement Corporation, Buffalo, New York, occurred on March 5th.

Twenty-Year Employees Honored by Northwestern States

Eighteen employees who have served with the Northwestern States Portland Cement, Mason City, Iowa, for twenty or more years, were honored at the annual company banquet, held Friday, February 6th, at a local hotel.

The "20 Year Club" came formally into being at that time and in token of the distinction a gold charm bearing the name of the bearer and a suitable inscription was presented by President MacNider to each of the members. Oldest in point of service and first to receive the charm was Fred Smith, plant superintendent, who has been with the company from the first.

B. A. MacDonald performed the duties of toastmaster and G. B. Pray was in charge of entertainment.

Dewey Portland Holds Convention for Salesmen

A three-day sales convention of the Dewey Portland Cement Company, Davenport, Iowa, opened at Dewey, Iowa, on February 5th. Salesmen from points in Kansas, Nebraska, Arkansas, Texas, Missouri and Oklahoma were in attendance. Walter Gray, general sales manager of Kansas City, was in charge.

Inspection of the plant and a banquet preceded the business sessions.

The gathering is held annually.

Herman Beck Rejoins Brother in Cement Business

Herman Beck has joined the Great Lakes Portland Cement Corporation, making his headquarters at Cleveland. Until the sale of the Limedale, Indiana, plant a few years ago, Mr. Beck had been associated there in the cement industry with his brother, Adam L. The latter is president of the Great Lakes firm.

Newaygo Annual Banquet

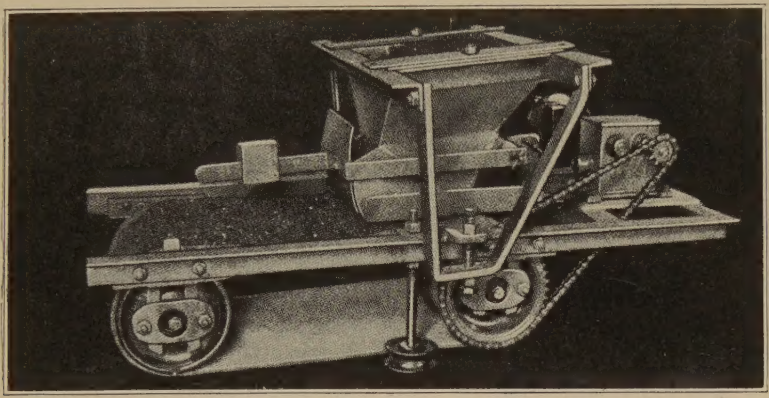
The fourteenth annual banquet of the employes of the Newaygo Portland Cement Company was held at a local auditorium early in February. About 150 employes and officials took part in the festivities.

W. A. Ansorge was chairman and Charles E. Wyman acted as toastmaster.

Mill Equipment

Hardinge Unit Features Weight Feeding

Close regulation by weight of the feed to kilns is the purpose of the Hardinge Constant Weight feeder. Its operation is described as follows: A traveling belt attached to a frame, on which the driving mechanism is also located, is suspended on two pivotted points so that any variation in the weight on the belt will move the frame, which in turn moves the feed gate. When the weight increases, this weights the belt and frame down and shuts the gate slightly. This automatically reduces the feed and thus brings the weight back to that originally set.



As a proportioning device, the manufacturer points out, two or more feeders delivering to a common point and controlled simultaneously, will weigh material at a constant rate so that the mixtures desired will be accurately proportioned. At the same time, a record is kept of the weight for a given period through the use of the revolution counters supplied.

The Hardinge Constant Weight Feeder is a product of the Hardinge Co., York, Pa.

Standardized Drives for Screw Conveyors Announced

Pursuant with their plan to standardize various driving mediums, H. W. Caldwell & Son Co., Chicago, have announced Caldwell standardized drives for screw conveyors.

This new drive for screw conveyors from 3 to 16 in. diameter, is described as compact, clean-cut and trim in appearance—highly efficient, positive, and quiet in operation.

The Caldwell screw conveyor drive is made in two arrangements—Type "C" and Type "D."

The Type "C" Drive consists of two speed reductions from motor to screw conveyor, each through a high grade power transmission medium—a Link-Belt Silent Chain Drive fully enclosed in an oil-retaining steel casing, and an efficient worm gear speed reducer, designed to serve as a thrust end and screw conveyor drive.

The Type "D" Drive consists of a direct coupled reducer, mounted with motor on unit base plate. This type of drive permits the selection of a Caldwell worm gear reducer according to horsepower rating, without regard to the size of the conveyor trough on which the drive is to be mounted.

Industrial Literature

Haynes Stellite Booklet

A new publication coming from the *Haynes Stellite Company*, Kokomo, Ind., is *"Properties of Haynes Stellite."*

It covers a general description of the Haynes Stellite alloys, an explanation of red hardness, the uses, physical properties, chemical properties and structure of the alloys.

The booklet is a 1930 edition, having been revised, brought up to date, and includes additional information which did not appear in previous issues.

"Black and White"

"The Houghton Line in Black and White" is a monthly publication, of which the April, 1930, issue is now being distributed by *E. F. Houghton & Co.*, Philadelphia, Pa.

"Steam Turbine Lubrication" is the title of its leading article, prepared by a member of the firm's research staff. Other articles deal with power plant operating economies, double belt economy, and lubrication of gears.

Pulverizing Mills

The Fuller Lehigh Company, Fullerton, Pa., announce a new publication circular 902 on pulverizing mills. This new 4-page booklet tells the economic and mechanical advantages of Fuller Lehigh mills, both of the air and of the screen separation type.

New Crusher Bulletin

Bulletin 3100 on the Bulldog Gyratory Crusher, Type T, supersedes 2100, and is now being distributed by the *Traylor Engineering and Manufacturing Company*, Allentown, Pa.

Notes from the Field

Turbine-Generator for Waste Heat at Alpha Plant

Among the contracts made recently by the *Westinghouse Electric and Manufacturing Company*, E. Pittsburgh, Pa., is one for a turbine-generator at the Alpha Portland Cement Company plant at Martins Creek, Pa.

This installation will be the largest single unit operating on waste heat in the world, it is said.

Sivyer Officers and Directors

At the stockholders' meeting of the *Sivyer Steel Casting Company*, of Milwaukee, recently consolidated with the *Nugent Steel Castings Company*, of Chicago, the following officers were elected: C. R. Messinger, chairman of the board; L. S. Peregoy, president; M. A. Fladoes, vice-president in charge of sales; George L. Pollock, secretary; C. A. MacDonald, treasurer.

The directors are: C. R. Messinger, W. C. Frye, Walter Kasten, Donald Fraser, C. F. Messinger, E. L. Wood, L. S. Peregoy, C. A. MacDonald, M. A. Fladoes, C. E. Stone.

Osborn Engineering Reorganizes

The Osborn Engineering Company, of Cleveland, Ohio, announce a reorganization of the company.

P. P. Evans is the new president, coming to the present office from the vice-presidency; *E. H. Birney*, formerly vice-president of the Peerless Drawn Steel Company of Massillon, Ohio, becomes the new vice-president; *T. T. Hubbard*, director of the company since 1912, is to be the treasurer and *Kenneth H. Osborn*, secretary.

Battery of Lehigh Pulverizing Mills with approximately 25 years of service.

LEHIGH MILLS
Find Ready Acceptance

EVER since the inception of the American cement industry, approximately 30 years ago, Lehigh Pulverizing Mills have been accepted as standard equipment for pulverizing coal and various rock products. Many of the mills placed in service during the early days of the industry are still operating, using low power consumption and with low maintenance.

Although the basic principles of the earlier mills have been retained, many outstanding improvements, results of continuous research and close contact of Fuller Lehigh engineers with the pulverizing field, are included in the mill shown in the illustration. Today, as during the earlier days, Lehigh Mills are standard equipment in many plants where materials are pulverized.

The economic advantages of Lehigh Mills are fully described in Bulletin 902. May we mail you a copy?

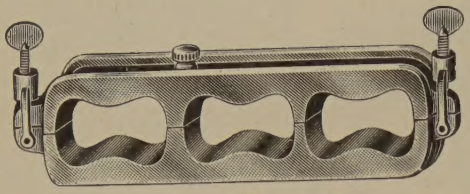
FULLER LEHIGH COMPANY
A Babcock & Wilcox Organization
FULLERTON, PENNA.

FULLER LEHIGH

1-176

PULVERIZED-COAL EQUIPMENT—WATER-COOLED FURNACE WALLS—ELVERITE CASTINGS

Laboratory Apparatus for Cement Testing



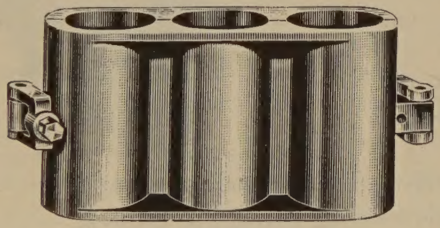
2406

Laboratory Tests for tensile strength and compressive strength of Portland Cement should be performed according to Standard A. S. T. M. Specifications. A very necessary requisite for these tests are molds according to A. S. T. M. design.

2404 BRIQUETTE MOLD—Single, of brass with end clamps for forming test pieces for tension tests. According to the dimensions specified in A. S. T. M. Test C 9-26 .... 4.20

2406 BRIQUETTE GANG MOLDS—A. S. T. M., of brass with end clamps.

No. of briquettes	2	3	4	5	6
Each	7.00	10.50	14.00	17.50	21.00



2423

2422 CYLINDRICAL MOLD—Brass, for preparing cylinders used in determining the compressive strength of Portland Cement Mortars. Diameter, 2 inches; height, 4 inches. According to the dimensions specified in A. S. T. M. Tentative Test C9-16T........ 3.25

2423 CYLINDRICAL MOLD—Triple, for preparing three cylindrical test pieces at one time. Diameter of each cylinder, 2 inches; height 4 inches........ 16.00

These molds are carried in stock for immediate delivery

For a complete listing of Cement Testing Apparatus and Chemical Laboratory Apparatus refer to Catalog C. Write for a copy if you do not have one.

THE CHEMICAL RUBBER CO.

Laboratory Apparatus and Chemicals

West 112th Street and Locust Avenue
Cleveland, Ohio

New York and Pennsylvania to Have Early Regional Meetings

Albany, New York, and Easton, Pennsylvania, are scheduled for early regional safety meetings sponsored by the Portland Cement Association.

The first will be held at the Hotel Ten Eyck on April 15th, with sessions from 8 to 10 A. M. and 2 to 5 P. M. F. F. Monaghan, superintendent for the Glens Falls Portland Cement Company, Glens Falls, N. Y., will act as chairman. The Alpha, Universal Atlas, Canada, Glens Falls, Lawrence, Lehigh, Lone Star New York, North American and the Pennsylvania-Dixie cement companies will be represented.

The Pennsylvania sessions, on May 29th, will be held from 1:30 to 5:30 P. M., and will be in charge of S. Henry Harrison, assistant superintendent of the Vulcanite Portland Cement Company. The United States Bureau of Mines will be represented by C. W. Jeffers. Participating mills will be the Allentown, Alpha, Universal Atlas, Giant, Hercules, Lawrence, Lehigh, Nazareth, Pennsylvania-Dixie, Lone Star (Pa.) Valley Forge and Vulcanite companies.

Two recent regional safety meetings held and sponsored by the Portland Cement Association were those at Cincinnati, Ohio, on February 11th, and at LaSalle, Illinois, on March 4th.

The former, held at the Hotel Gibson, was attended by 66 delegates from Southern Ohio, West Virginia, Kentucky and Indiana. A. J. R. Curtis, assistant to the general manager of the association, told how accidents in the cement industry had been reduced 68 per cent since 1925. The Cincinnati mayor welcomed the delegates and Fred Hoehler, city welfare director, spoke at the afternoon session. A dinner meeting was held in the early evening.

Officials and safety campaign leaders to the number of 125 attended the Illinois meeting.

Henry McClarnan, general superintendent of the Alpha Portland Cement Company, called the meeting to order at 10 o'clock at the Illinois Valley Manufacturers' club.

A third regional meeting was held at Dallas, Texas, on February 4th, when 118 men represented 7 plants in the district. Lewis R. Ferguson, vice-president, Lone Star Cement Co., Texas, was the general chairman.

North American Profit

The North American Cement Corporation for the year ended December 31, reports net sales of $4,863,582 and net profit of $1,433,074. After allowing for interest, depreciation and depletion and federal income tax, net income for the year was $282,294. The balance sheet as of December 31 shows current assets of $2,052,115, including $778,979 cash, $258,047 accounts receivable, and inventory, $1,015,088. Current liabilities were $535,659.

International Earnings

The International Cement Corporation report of operations for 1929 shows net profits of $4,909,232, equal to $7.82 a share on 627,865 no par common shares, as against $5,149,388, or $7.90 a share in 1928.

Safety Council Moves

The headquarters office of the National Safety Council has been moved from 108 E. Ohio Street to the 20 North Wacker Drive building, Chicago.